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FINAL PHASE II(a) RESPONSE PLAN FOR IMPACT AREA RDX DETECTIONS IN GROUNDWATER

FOR THE
CAMP EDWARDS IMPACT AREA GROUNDWATER QUALITY STUDY

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TABLE OF CONTENTS

1.0 INTRODUCTION 1

2.0 INVESTIGATION FINDINGS 2

- 2.1 GROUP 1 WELLS 2
  - *2.1.1 MW-2* 2
  - *2.1.2 MW-26 and MW-59* 2
  - *2.1.3 MW-41* 3
  - *2.1.4 MW-50* 3
  - *2.1.5 Bourne 95-6 Well Cluster* 4
  - *2.1.6 Particle Track Analysis* 4
- 2.2 GROUP 2 WELLS 6
  - *2.2.1 MW-23* 6
  - *2.2.2 MW-42* 6
  - *2.2.3 MW-43* 7
  - *2.2.4 MW-44* 7
  - *2.2.5 Particle Track Analysis* 7
- 2.3 GROUP 3 WELLS 8
  - *2.3.1 MW-1* 9
  - *2.3.2 MW-38* 9
  - *2.3.3 MW-39* 10
  - *2.3.4 MW-40* 10
  - *2.3.5 MW-37* 11
  - *2.3.6 Particle Track Analysis* 11

3.0 PROPOSED INVESTIGATIONS 14

- 3.1 GROUNDWATER 14
- 3.2 SOIL 16

4.0 REFERENCES 16

Tables

Table 1. Monitoring Well Screen Intervals and RDX Concentrations 16
Table 2. Groundwater Profile Sample Results 18
Table 3. Proposed Groundwater Monitoring Well Details 29

Figures

Figure 01. Concentration of RDX and HMX in Group 1, 2, and 3 Groundwater Wells 30
Figure 02. MW-59S Particle Track and Cross Section 31
Figure 03. MW-44S Particle Track and Cross Section 32
Figure 04. MW-01S Particle Track and Cross Section 33
Figure 05. MW-01M2 Particle Track and Cross Section 34
Figure 06. Proposed RDX Response Plan Wells in the Impact Area 35
Figure 07. MW-40M1 Plan View Particle Track 36
Figure 08. MW-40M1 Particle Track and Cross Section 37
Figure 09. MW-37M2 and MW-37M3 Plan View Particle Track 38
Figure 10. MW-37M2 and MW-37M3 Particle Track and Cross Section 39

Attachments

Attachment 1. Draft Soil Sampling Plan for MW-26/59 Location 40
Attachment 2. Response to USEPA Comments 42
Attachment 3. Response to MADEP Comments 47

1.0 Introduction

Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX), bis (2-ethylhexyl) phthalate, and several inorganic analytes were detected at concentrations exceeding drinking water standards and health advisories in groundwater samples collected during Phase I of the Camp Edwards Impact Area Groundwater Study (IAGS). Section A of the subsequent Phase II(a) Workplan proposed investigation activities designed to characterize the nature and extent of these compounds detected in groundwater in or originating from the Impact Area. Phase II(a) included resampling Phase I wells to confirm earlier detected concentrations, installing additional monitoring wells up- and down-gradient to assess the extent of contaminant migration, and soil sampling to identify potential source area(s).

Based on preliminary Phase II(a) findings, the U.S. Environmental Protection Agency (EPA) requested preparation of a Response Plan for further characterization of RDX in the Impact Area. The RDX has been identified in wells that are located along three flow paths, as indicated in Figure 1. These flow paths were plotted by the U.S. Geological Survey (USGS) using the three-dimensional groundwater flow model MODFLOW. The northernmost flow path includes wells MW-2, MW-26, MW-41, MW-50, and MW-59, and is identified as Well Group 1 in this plan. The central flow path includes wells MW-23, MW-42, MW-43, and MW-44, and is identified as Well Group 2. Well Group 3, the southernmost flow path, includes MW-1, MW-38, MW-39, and MW-40.

This Phase II(a) Response Plan presents an analysis summary of Phase I and Phase II(a) RDX data in groundwater for each of the well groups, and proposes follow-up investigation activities designed to further characterize the nature and extent of RDX contamination. RDX contamination in groundwater at the Demolition 1 Area and the J Ranges will be investigated separately.

The technical approach used in assessing RDX contamination was to identify potential up-gradient source areas and assess down-gradient migration by correlating groundwater flow paths with the distribution of RDX in groundwater determined during Phase I and Phase II(a). Based on this preliminary analysis, certain informational gaps were identified, and additional investigation activities were developed. Supplemental investigation activities presented in this response plan include:

- installation of additional monitoring wells upgradient, downgradient and cross-gradient from areas were RDX was detected in order to define limits of groundwater migration, and

- collection of soil samples in areas where the groundwater flow model predicts possible source(s) of RDX contamination exist.

2.0 Investigation Findings

The following sections provide detailed summaries of Phase I and Phase II(a) investigation findings focused on RDX in groundwater for the three selected well groups.

2.1 Group 1 Wells

The Group 1 monitoring wells are those installed along the northernmost RDX particle track identified in Figure 1, and include well clusters MW-26 and MW-2 which were installed between October 1997 and January 1998, and MW-59, MW-41, and MW-50 installed between February and March 1999. A summary of well construction details and detected explosives compound concentrations for the Group 1 wells is presented in Tables 1 and 2. Depth references presented relative to the water table should be considered approximate due to the natural, seasonal variation in water table elevations.

Because of its proximity to the Group 1 flow path at the MMR property boundary, the Bourne 95-6 long range future water supply well cluster was included in the evaluation of distant down-gradient contaminant migration. This location is approximately 280 feet south of the flow path from the Group 1 wells.

2.1.1 MW-2

The MW-2 well cluster was installed during Phase I of the IAGS and is where explosive compounds along the Group 1 flow path were first discovered. The MW-2 well cluster consists of four wells completed at various depths within the aquifer ranging from the water table to 221 feet below water table (bwt). Explosive compounds have only been detected in well MW-2M2 screened between 31 and 36 feet bwt. RDX was detected at a concentration of 13 ug/L in January 1998, and RDX and octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX) were detected at concentrations of 6.8 and 0.3 ug/L, respectively, in February 1999 (Table 1).

There was one detection of RDX in the profile samples from the boring for MW-2. Profile samples extended from the water table to 221 feet bwt. As indicated in Table 2, RDX was detected at 6.6 ug/l in the profile from 170-175 feet below ground surface (bgs), which corresponds to about 33-38 feet bwt based on the boring log. The MW-2M2 well screen was installed between 31 and 36 feet bwt to assess this profile interval.

2.1.2 MW-26 and MW-59

MW-26 and MW-59 represent the furthest up-gradient well clusters installed along the Group 1 groundwater flow paths. Because of their close proximity and similar contaminants, analysis of data from wells at MW-26 and MW-59 are considered together.

Down-gradient well clusters in this group (MW2, MW-41, MW-50, and 95-6) are located at distances of 700, 3,100, 6,900, and 12,400 feet from MW-26 and MW-59 (Figure 1).

A single water table well (MW-26S) was installed upgradient from MW-2 to assess contaminant concentrations in a former clearing on the east side of Turpentine Road. Explosive compounds were not detected in the initial, February 1998 sampling of this well. During the March 1999 sampling of MW-26S, RDX and HMX were detected at concentrations of 0.49 and 0.3 micrograms per liter (ug/L), respectively (Table 1). No groundwater profiling was conducted at the boring for MW-26.

The MW-59 well cluster was installed during Phase II approximately 50 feet cross-gradient from MW-26S to evaluate groundwater quality closer to the particle track from MW-2, and deeper within the aquifer. The MW-59 well cluster consists of wells installed at three depths ranging from the water table to 40 feet bwt (Table 1). Consistent with the MW-26S results, RDX and HMX were detected in water table well MW-59S during two sampling events in 1999. RDX and HMX concentrations in this well in March 1999 were 1.0 and 0.84 ug/L, respectively. Comparable concentrations of 0.82 and 0.81 ug/L were detected later in May 1999 (Table 1).

There was one detection of HMX in the groundwater profile samples from the boring for MW-59. Profile samples extended from the water table to 91 feet bwt. As indicated in Table 2, HMX was detected at 0.62 ug/l in the profile from 135 feet bgs, which corresponds to about 5 feet bwt based on the boring log. This was the uppermost profile sample collected at the MW-59 boring. The MW-59S well screen was installed at the water table to assess this profile sample.

2.1.3 MW-41

The MW-41 well cluster was installed during Phase II of the IAGS to assess groundwater quality down-gradient of the MW-2 well cluster. The three wells of the MW-41 cluster are completed at depths within the aquifer ranging from the water table to 120 feet bwt (Table 1). No explosive compounds were detected in these three wells during the April 1999 sampling event, the only time these wells were sampled.

There were no detections of RDX or HMX in the groundwater profile samples from the boring for MW-41. Profile samples extended from the water table to 124 feet bwt.

2.1.4 MW-50

The MW-50 well cluster, installed during Phase II, consists of five wells screened at various depths within the aquifer ranging from the water table to 128 feet bwt. The MW-50 well cluster represents the furthest down-gradient monitoring location along the Group 1 particle track from which representative groundwater samples have been collected.

Only well MW-50M1, which is screened between 88 and 98 feet bwt, exhibited detectable concentrations of RDX (1.9 ug/L) during the April 1999 sampling round.

There were three detections of RDX in the groundwater profile samples from the boring for MW-50. Profile samples extended from the water table to 202 feet bwt. As indicated in Table 2, three consecutive profile samples had RDX detected, at concentrations from 2.8 to 4.8 ug/l. These samples were collected at depths between 200 and 225 feet bgs, which correspond to about 83 to 108 feet bwt. The screened interval for MW-50M1 (93 to 103 feet bwt) was positioned to assess this profile interval.

2.1.5 Bourne 95-6 Well Cluster

The 95-6 long-range future water supply wells were installed in 1995 and 1997 as part of a municipal water supply aquifer study. The well cluster is not precisely centered on the Group 1 flow path, but they are close enough to provide groundwater quality data at this distant down-gradient location adjacent to the MMR property boundary. The 95-6 cluster is located approximately 280 feet south of the flow path (Figure 1).

A groundwater sample was collected from well 95-6, the original galvanized steel well at this location, in October 1997, and was non-detect for explosive compounds. This well is screened between 62 and 74 feet bwt. A group of PVC wells was subsequently installed at this location, and well 95-6B was sampled in March 1999. Results were non-detect for explosive in this screen, which is 93-103 feet bwt. Other new PVC wells at this location are screened at the water table and deeper in the aquifer, but have not been sampled for explosive compounds. At the request of EPA, two of these wells were added to the Phase I sampling program in the fall of 1999. Well 95-6A, screened 142-152 feet bwt, was sampled November 9 and was non-detect for explosives. Well 95-6E(S), screened at the water table, was sampled November 16 and explosives results are not yet available.

2.1.6 Particle Track Analysis

Wells MW-26S and MW-59S are presumed to be located near the source of contamination found in the Group 1 wells because of the presence of explosive compounds at the water table. A forward particle track was plotted from the water table at the MW-59 well cluster and is depicted in cross-section view in Figure 2. Note that this particle track passes slightly above the RDX detections at MW-2 and MW-50, as discussed in detail below. Therefore, a backward particle track from the contamination at MW-50 would extend southeast from MW-59, since it would be parallel to the track shown in Figure 2. It is not possible to show multiple particle tracks on a single section view at this time. The flow path for Group 1 wells in Figure 1 is actually an overlay of the particle tracks extending forward from MW-59S and extending backward from MW50M1.

The groundwater flow path represented by the particle track in Figure 2 passes from MW-59S through, or near, the well screens of MW-2M2, MW-41M2, and MW-50M1. The flow path is generally downward at a decreasing rate, although there is a slight upward trend west of the Impact Area boundary as groundwater enters the moraine. Near the western MMR property boundary, the MW-59S flow path passes alongside the well screen at Bourne 95-6B. The flow path ends by discharging to the Cape Cod Canal.

Three of the four IAGS well screens nearest the MW-59S particle track (MW-59S, MW-2M2, and MW-50M1) have had samples with RDX detected, including the MW-59S screen. The MW-2M2 well screen is positioned about 5 feet below the particle track, and exhibited the highest concentrations of RDX in Group 1. The estimated travel time between MW-59S and MW-2M2 is approximately 6 years, which was derived using the USGS groundwater flow model for a particle starting at the water table at MW-59S. One groundwater profile sample from the MW-2 boring also indicated RDX, at about 10 feet below the particle track. The MW-50M1 well screen is positioned about 5 feet below the particle track, and had RDX detected at about one-third the concentration measured in MW-2M2. Three groundwater profile samples from the MW-50 boring also indicated RDX, from about 10 feet above to 10 feet below the particle track.

Except for the absence of RDX in the groundwater profiles and well screens sampled at MW-41M2, groundwater quality data for the Group 1 wells show a strong relationship between the flow path and the distribution of RDX. From these data, it is inferred that groundwater contaminants have been introduced to groundwater in the vicinity of MW-26 and the MW-59 well cluster, and have migrated down-gradient along the flow path to at least the MW-50 well cluster. The extent of migration beyond MW-50M1 has not been determined. The non-detect at the Bourne 95-6B screen is located approximately 280 feet south of the modeled flow path. The absence of detects at MW-41 is likely the result of either variation in localized migration paths due to inhomogeneity in aquifer hydraulic properties in the vicinity of the well screen, or that the source is pulsed such that the contaminants at MW-50 have already passed through the MW-41 location.

It is possible that contaminants have been introduced to groundwater somewhat upgradient from MW-59. This possibility would explain the detections at MW-50 and MW-2 being slightly below the particle track from MW-59. If true, the source area would be expected to be relatively close to MW-59, since the screen where contaminants were sampled extends only 9 feet bwt.

2.2 Group 2 Wells

The Group 2 monitoring wells are those installed along the centrally-located RDX particle track identified in Figure 1, and include well cluster MW-23 installed in July and September 1997, and MW-42, MW-43, and MW-44 installed between February and April

1999. A summary of well construction details and detected explosives compound concentrations for the Group 2 wells is presented in Table 1. As with the Group 1 wells, depth references relative to the water table should be considered approximate due to the natural, seasonal variation in water table elevations.

2.2.1 MW-23

The MW-23 well cluster was installed during Phase I of the IAGS and is where explosive compounds were first discovered along the Group 2 flow path. The MW-23 cluster consists of five wells installed at depths within the aquifer ranging from the water table to 158 feet bwt. RDX has been detected in both groundwater samples collected from well MW-23M1 of this cluster, which is screened on the interval from 101 to 111 feet bwt. An RDX concentration of 2.3 ug/L was detected in this well in November 1997. In March 1999, similar concentrations of 4.4 and 4.7 ug/L were detected in the sample and its duplicate collected from this well. None of the other wells in this cluster have shown detectable concentrations of RDX (Table 1).

Groundwater profile samples were collected from the water table to 170 feet bwt at the MW-23 boring. These samples were analyzed using a screening level analysis for RDX, HMX, TNT, and DNT. The method reporting limit for this analysis was 10 ug/l. There were no explosive compounds detected in the profile samples.

2.2.2 MW-42

The MW-42 well cluster was installed during Phase II to assess groundwater quality down-gradient of well MW-23M1. The cluster consists of three wells completed at different depths within the aquifer ranging from 99 to 149 feet bwt. None of the three wells in this cluster exhibited detectable concentrations of explosives in May 1999, the only time these wells were sampled. The MW-42 well cluster represents the furthest down-gradient monitoring location along the Group 2 particle track.

There were no detections of RDX or HMX in the groundwater profile samples from the boring at MW-42. This boring was profiled from 4 feet bwt to 158 feet bwt.

2.2.3 MW-43

The MW-43 well cluster was also installed during Phase II to assess groundwater up-gradient of the explosives reported in MW-23M1. The cluster is located on the Impact Area boundary and consists of three wells completed at various depths within the aquifer ranging from the water table to 103 feet bwt. In May 1999, RDX was detected in well MW-43M2 (screened between 70 and 80 feet bwt) at a concentration of 0.64 ug/L. Detectable concentrations of RDX were not found in either of the other two wells in this cluster including the water table well during the May sampling event (Table 1).

There were no detections of RDX or HMX in the groundwater profile samples from the boring at MW-43. Other explosive compounds were detected but not confirmed with PDA. The absence of explosive detections in the profile samples and the presence of RDX in the monitoring wells is unclear at this time. A detailed analysis of this situation will be performed as part of the report (Tech Memo 99-6) comparing groundwater profile and monitoring well results. This boring was profiled from the water table to 145 feet bwt.

2.2.4 MW-44

The MW-44 well cluster was installed in conjunction with the MW-43 cluster to assess groundwater conditions further up-gradient and presumably closer to a potential source area within the Impact Area. The well cluster consists of three wells screened at 0 to 10, 15 to 25, and 55 to 65 feet bwt. Due to worker safety issues related to unexploded ordnance (UXO), the sampling of this well cluster was delayed. There were no detections of explosives in the unvalidated results for the MW-44 monitoring wells.
There were no detections of RDX or HMX in the groundwater profile samples from the boring at MW-44. This boring was profiled from 10 feet bwt to 110 feet bwt.

2.2.5 Particle Track Analysis

MW-42 was installed along the forward particle track from MW-23M1 that was modeled by USGS, and MW-43 and MW-44 were installed along the reverse particle track from this screen. A section view of the groundwater flow path for the Group 2 wells is provided in Figure 3. The flow path is represented by a forward particle track from MW-44S. The flow path is generally downward at a decreasing rate, although there is a flat trend at the Impact Area boundary as groundwater enters the moraine. Near the western MMR property boundary, the flow path moves upward slightly and then flattens. The flow path ends by discharging to the Cape Cod Canal.

Currently it is not possible to depict both the forward and backward tracks from MW-23M1 on one figure. Note that the flow path in Figure 3 passes slightly above the screen at MW-23M1, as one would expect since MW-44 was installed slightly downgradient from the southeast end of the particle track from MW-23M1. Or, put another way, the backward and forward particle tracks for MW-23M1 are slightly below (and parallel to) the flow path in Figure 3. The plan view of the flow path for Group 2 wells in Figure 1 is an overlay of the particle tracks extending forward and backward from both MW-43M2 and MW-23M1. The southeast end of this flow path represents the backward track from MW-23M1, which had the deepest detection in this group.

Two additional wells have been installed cross-gradient to MW-23 and include MW-72S and the MW-51 well cluster. MW-72S is located 445 ft south of the Group 2 particle track and MW-51 is located 735 ft north of the Group 2 particle track. MW-72S is a water table well. Five well screens have been installed at MW-51 between the water table and 129 ft bwt. Explosives have not been detected in any of these monitoring wells, which have been sampled once. These results suggest the Group 2 area of contamination is separate from Group 1.

The flow path illustrated in Figure 3 shows a modest relationship between the model-predicted flow path and the observed distribution of RDX in Group 2 wells. RDX has been detected in groundwater at two locations in the Group 2 wells, in MW-43M2 and in MW-23M1. The flow path passes between the two zones where RDX was detected, 5 feet below the screen at MW-43M2, and then through the top of the MW-23M1 screen. The concentrations in the two screens are relatively low, 2-10 times the reporting limit. The absence of RDX in the MW-42 down-gradient wells and profile samples suggests that the low levels of RDX in the MW-23M1 screen have not migrated this far downgradient or have dispersed or diluted to below the detection limit. The absence of RDX in the MW-44 upgradient groundwater well could have several explanations, including:

- Contaminants at MW-44 may have already been flushed out of the source area; or

- MW-44 may have been installed upgradient from the source area, i.e. too far southeast along the backward particle track from MW-23M1. This possibility is supported by the RDX detected at MW-43M2 above the forward particle track from MW-44S or the backward particle track from MW-23M1. If the contamination at MW-43M2 and MW-23M1 is the same material, then the modeled flow path should be steeper and would intersect the water table northwest of MW-44.

2.3 Group 3 Wells

The Group 3 monitoring wells are those installed along the southernmost RDX particle track identified in Figure 1, and include well cluster MW-1 installed between September and December 1997, and MW-38, MW-39, and MW-40 installed in March and April 1999. MW-37 was also installed south of this area in April 1999, as part of the investigation of conditions upgradient from CS-19. A summary of well construction details and detected explosive compound concentrations for the Group 3 wells is presented in Table 1.

2.3.1 MW-1

The MW-1 well cluster was installed during Phase I of the IAGS and is where explosive compounds along the Group 3 flow path were first discovered. The MW-1 well cluster consists of four wells completed at various depths within the aquifer ranging from the water table to 184 feet bwt. Explosive compounds have been detected in the upper two wells (MW-1S and MW-1M2) screened at the water table and between 44 and 49 feet bwt.

At the water table (in MW-1S), RDX has been detected at concentrations of 2.5 and 2.8 ug/L in September 1997 and February 1999, respectively (Table 1). A duplicate sample collected in September exhibited an RDX concentration of 2.4 ug/L, consistent with the 2.5 ug/L detected in the primary sample. HMX was also detected in MW-1S at concentrations of 0.59 and 0.53 ug/L in the primary and duplicate samples collected in September 1997, and an estimated concentration of 0.63 ug/L in February 1999.

In MW-1M2, RDX has been detected at concentrations of 4.6 and 2.2 ug/L in September 1997 and March 1999, respectively (Table 1). The 4.6 ug/L RDX concentration represents the highest concentration detected in the Group 3 wells for that compound. HMX was not detected in this well.

RDX and HMX were also detected in four groundwater profile samples between the water table and the MW-1M2 screen; at 5, 15, 25, and 47 feet bwt (Table 2). The RDX concentrations for these profile samples were 2.9, 5.6, 0.95, and 5.9-7.6 ug/l. There was generally agreement between the RDX concentrations in the profile and screen samples at MW-1, with the profile concentrations about 20-50% higher than the screen concentrations. Note that the profile samples were withdrawn from a very small depth interval, essentially a point at the bottom of the screened drill rod, whereas the wells were screened over 10-foot intervals.

2.3.2 MW-38

The MW-38 well cluster was installed during Phase II to assess groundwater quality down-gradient of the MW-1 well cluster. The are six MW-38 wells completed at different depths within the aquifer ranging from the water table to 135 feet bwt. RDX was detected in two wells, MW-38M3 and MW-38M4, in May 1999, the only time these wells were sampled. RDX was detected at 2.5 ug/L in MW-38M3, which is the deeper of the two, screened between 50 to 60 feet bwt. In MW-38M4, screened between 12 and 22 feet bwt, RDX was detected at 1.2 ug/L. The remaining four wells in the MW-38 cluster exhibited no detectable concentrations of RDX.

RDX and HMX were detected, but not confirmed with PDA, in several groundwater profile samples from the boring at MW-38. The RDX detections were at 13, 23, 53, and 63 feet bwt. The discrepancy between the groundwater profile and monitoring well results is not clear at this time. A detailed analysis of this situation will be performed as part of the report (Tech Memo 99-6) comparing groundwater profile and monitoring well results. The HMX detections were at 13 and 23 feet bwt. Groundwater profile samples were collected between 13 and 157 feet bwt.

2.3.3 MW-39

The MW-39 well cluster was also installed during Phase II to assess groundwater down-gradient of the MW-1 well cluster. The MW-39 cluster is located on the Impact Area boundary and consists of three wells completed at various depths within the aquifer ranging from the water table to 97 feet bwt. MW-39 represents the furthest down-gradient well cluster along the Group 3 particle track.

In May 1999, HMX was detected in well MW-39M2 (screened between 42 and 52 feet bwt) at a concentration of 0.7 ug/L. No detectable explosives were observed in the other two wells during the May sampling event (Table 1).

Groundwater profile samples were collected between 7 and 150 feet bwt at the boring for MW-39. RDX was detected, but not confirmed, in several of these samples. The RDX detections were at 27, 37, 47, 87, 97, and 127 feet bwt. There was a confirmed HMX detection at 47 feet bwt. The MW-39M2 screen was installed to assess this profile interval.

2.3.4 MW-40

The MW-40 well cluster represents the furthest up-gradient well installed along the Group 3 particle track. The other well clusters in this group (MW-1, MW-38, and MW-39) are located down-gradient at distances of 700, 3000, and 3800 feet, respectively (Figure 1). The MW-40 well cluster was installed during Phase II to assess groundwater conditions upgradient from the detection at MW-2M2. The well cluster consists of two wells screened at the water table and at 16 to 26 feet bwt.

Due to worker safety issues related to UXO, the sampling of this well cluster was delayed. Unvalidated data from these wells indicates the presence of RDX. The completed monitoring well, MW-40M1, has a well screen from 16 to 26 ft bwt. RDX was detected at a value of 2.8 ug/L and at 2.6 ug/L in the duplicate sample. These results are unvalidated but have been confirmed with PDA. The data from MW-40S does not indicate the presence of RDX. MW-40S was installed at the water table.

RDX was detected, but not confirmed by PDA, in several groundwater profile samples from the boring at MW-40. The RDX detections were at 15 and 105 feet bwt. Groundwater profile samples were collected at 10-foot intervals between 15 and 105 ft bwt at the MW-40 boring. The reasons for the apparent absence of RDX in the profile samples from 15 and 25 feet bwt, and its presence in the monitoring well screened from 16-26 feet bwt, are unclear at this time. A detailed analysis of the agreement between profile results and monitoring well results for explosives is currently being prepared as Tech Memo 99-6.

2.3.5 MW-37

The MW-37 well cluster is located south of the Group 3 particle track, and upgradient of the CS-19 area. RDX was detected but not confirmed in the groundwater profile samples G37MBA, G37MCA, and G37MDA collected at depths of 16, 26, and 36-ft bwt, respectively. The monitoring wells MW-37M2 and MW-37M3 screened at depths of 28 to 38 and 13 to 23 ft bwt respectively indicated the presence of RDX, which was confirmed with PDA. RDX was detected in MW-37M2 at a concentration of 1.1 ug/L and the level in MW-37M3 was 2.9 ug/L. Neither well sample result has been validated.

The reasons for the apparent absence of RDX in the profile samples from 16 and 36 feet bwt, and its presence in the monitoring wells screened from 13-23 feet bwt and 28-38 feet bwt, are unclear at this time. A detailed analysis of the agreement between profile results and monitoring well results for explosives is currently being prepared as Tech Memo 99-6.

2.3.6 Particle Track Analysis

MW-38 and -39 were installed along the forward particle tracks from MW-1S/1M2 that were modeled by USGS, and MW-40 was installed along the reverse particle track from MW-1M2. Section views of the groundwater flow paths for the Group 3 wells are provided in Figures 4 and 5. The flow paths are represented by forward particle tracks from MW-1S and –1M2. The flow paths are generally downward at a decreasing rate, although there is a slight upward trend at the Impact Area boundary as groundwater enters the moraine. Near the western MMR property boundary, the flow paths again move upward slightly and then flatten. The flow paths end by discharging to the Cape Cod Canal. Currently it is not possible to depict both the forward and reverse tracks from MW-1M2 on one figure, nor to place the forward tracks from MW-1S and MW-1M2 on the same figure.

The flow path for MW-1S (Figure 4) passes through the screen at MW-38M3, then through the boring at MW-39 which was profiled from the water table to 150 feet bwt. The detections of similar concentrations of RDX at MW-1S and MW-38M3 suggest that this compound has migrated from a source area near MW-1 to at least the MW-38 location, and a continuing source of RDX may be present near MW-1. The absence of RDX in the groundwater profile samples from MW-39 suggests that the low levels of RDX have not migrated this far downgradient or have dispersed or been diluted to below the detection limit.

The flow path for MW-1M2 (Figure 5) passes about 5 feet above the well screen for MW-38M1, and near the lower end of the MW-39M1 screen. Neither of these down-gradient wells exhibited detectable concentrations of RDX in the May 1999 sampling event. Profile samples from these borings did not indicate the presence of RDX along the particle track depth.

Profile samples from the upgradient boring at MW-40 did not indicate the presence of RDX, although profiling at this location did not extend to the water table, due to difficulty in identifying the water table during drilling. The shallowest profile sample from boring MW-40 was from 15 feet bwt. However, MW-40S installed at the groundwater table did not indicate the presence of RDX. Unvalidated data from MW-40M1 indicates the presence of RDX. The plan view flow path is essentially the same as the MW-1S and MW-1M2 tracks (Figure 7). The cross-sectional view flow path for MW-40M1 is approximately 60 ft deeper than the MW-1S track and 15 ft deeper than the MW-1M2 track (Figure 8). The contamination present at MW-1M2 may be related to the detection at MW-40M1. The source area for the RDX detections appears to be upgradient of the MW-40 well cluster, since RDX was not detected in the MW-40S water table well.

The absence of RDX in downgradient wells and borings suggests that the RDX detected at MW-40M1 and MW-1M2 may not have migrated as far as MW-38, or may have dispersed or been diluted to below the detection limit. It does not appear to be likely that MW-38 is located off of the flow path from MW-1, considering the apparent relationship between the detections at MW-1S and MW-38M3.

Explosive detections were also observed at MW-38M4 (RDX) and MW-39M2 (HMX). These shallow screens are located approximately 30 and 40 feet, respectively, above the flow path for MW-1S. Therefore, it appears that these detections are unrelated to the contamination at MW-1. Considering the shallow depths, 12-22 feet bwt for MW-38M4 and 42-52 feet bwt for MW-39M2, the contaminants at these locations appear to have sources located in the area between MW-1 and MW-39. The area between MW-1 and MW-39 is amenable to the collection of soil samples, if necessary, after UXO clearance. The primary historic features in this area are CS-19 and mortar targets 1 and 2 (see Mortar Target FSP).

The flow path in plan view for MW-37M2 and MW-37M3 tracks parallel and south of the Group 3 track and extends beneath the CS-19 area (Figure 9). In cross-sectional view, the MW-37M2 and MW-37M3 particle tracks parallel the Group 3 track from MW-1M2 but at depths of up to 30 ft below the MW-1M2 track (Figure 10). This suggests that the MW-37M2 and MW-37 M3 RDX detections are unrelated to the Group 3 detections. Furthermore, the cross-sectional view of the MW-37M2 and MW-37M3 indicate the flow paths are below the detections at the CS-19 area. This result suggests the contamination at the CS-19 area may be unrelated to the detections at MW-37M2 and MW-37M3.

3.0 Proposed Investigations

The following investigation plans are designed to build on available extent of groundwater flow and explosives distribution data presented above to better define the subsurface migration and assess potential source area(s). Work will be initiated after response plan approval by EPA and MADEP subject to scoping and funding by the Guard.

3.1 Groundwater

Additional data are needed to define the lateral extent of contamination along each of the three flow paths. Dispersion along each flow path is likely, but as yet has not been measured. Efforts are underway to measure the lateral extent of groundwater contamination from the Demo 1 area, which may be useful for estimating the lateral spread of contaminants from the Impact Area flow paths.

The Guard has selected 21 locations in the Impact Area for placement of monitoring wells designed to provide additional data on lateral, upgradient, and downgradient RDX concentrations in groundwater. The lateral distribution of RDX in groundwater will be determined through the installation of two linear transects of monitoring wells, as shown in Figure 6 (P-1 to –9, and P-10 to –17). The transects intersect the Group 1, 2, and 3 flow paths at points selected to take advantage of existing wells and, to the extent practical, follow existing roads to minimize access limitations. Three upgradient wells (P-18, P-19, and P-20) are also located along the three flow paths to assess groundwater quality at, and possibly beyond, the presumed source areas for each. A single well (P-21) is proposed to be located downgradient of the Group 3 wells to evaluate the extent of contaminant migration along that flow path.

The approach for well installation will be to complete the inner transect wells (P-1 to –9) first, and use data from these borings to adjust well positions on the outer transect. The nominal spacing of wells along the inner transect is approximately 270 feet, and along the outer transect it is approximately 390 feet. If results from the inner transect suggest narrow contaminant flow paths, or additional contaminants not previously detected, the outer transect wells may be shifted accordingly. The upgradient and downgradient wells will be installed last, making use of the results from the transect installations to adjust these positions. Within an individual transect the wells closest to the predicted particle track will be drilled first. The placement of additional wells further out along the transect will be based on the findings at the inner locations. In some instances, all of the proposed wells along a given transect may not be drilled. This decision will be made in conjunction with the regulatory agencies. Wells not drilled as part of the transect may be drilled at alternate locations, chosen in consultation with the regulatory agencies. Therefore, additional boring locations may be added depending upon the findings in the field.

Well installation is scheduled to begin after groundwater profile results are available for the transect wells at Demotion Area 1, as proposed in the Response Plan for Demolition Area 1 (Ogden, 1999a). The results of the Demo 1 study will be used optimize the locations of Impact Area transect wells proposed in this plan.

Table 3 provides a list of the proposed monitoring wells, their preliminary screen depths, and proximity to existing wells where explosive compounds have been detected. The proposed screen intervals for each of the new wells listed in Table 3 will be refined based on groundwater profiling results determined at the time of installation.

Soil borings advanced for the inner transect wells will be drilled to a depth of 80 feet bwt as will the three upgradient wells. For the outer transect wells, soil borings will be advanced to a depth of 100 feet bwt. The soil boring for well P-21 will be advanced to a depth of 150 feet bwt. Groundwater profiling will be conducted in all the proposed soil borings at 10-foot intervals from the water table to the proposed bottom depth. Profile samples will be analyzed for explosive compounds using EPA Method 8330. Soil samples will be collected on 10-foot intervals in the unsaturated zone and analyzed for explosive, inorganic, and other Phase I analytes according to the frequency established for the Phase I work.

Two wells are proposed for each of the inner transect locations; one screened at the water table and the other screened over a 10-foot interval in the depth range between 25 to 45 feet bwt. Three wells are proposed for each of the outer transect well borings. One well will be screened at the water table, and it is anticipated that the intermediate wells in each of these borings will be screened over a 10-foot interval between 25 to 45 feet bwt, with the deep wells screened over a 10-foot interval between 65 to 85 feet bwt. Five wells are proposed for the single Group 3 downgradient well site P-21. The shallow well will be screened at the water table, and it is anticipated that the deepest well will be screened over a 10-foot interval between 120 to 140 feet bwt. The remaining three intermediate wells will be evenly distributed between the upper and lower well screens.

Final selection of well screen placement will be determined based on the groundwater profiling results in consultation with EPA. Each of the newly installed wells will be sampled for analysis of propellants, explosives, and pyrotechnic (PEP) compounds by EPA Method 8330.

It is likely that additional information on groundwater quality will become available prior to mobilization for these well installations, therefore, the well locations proposed above may be modified accordingly in consultation with EPA. The results of additional groundwater investigations at Demo 1 may also be useful for designing the Impact Area investigations.

3.2 Soil

A draft soil sampling plan dated July 26, 1999 has been prepared for the MW-26 and –59 area, and submitted to EPA (see Attachment 1). The plan includes collecting near surface soil samples from locations upgradient of MW-59 near the end of the particle backtrack in an attempt to identify a possible source of RDX. The sample grids are comprised of 5 sampling points arranged in a line perpendicular to, and bisecting the extension of the Group 1 particle backtrack from MW-2M2. Each of the five grid lines will be sampled at three depth intervals resulting in a total of 15 composite soil samples. The samples will be analyzed for explosive compounds using EPA Method 8330.

Similar surface soil sampling plans will be considered and proposed for the Group 2 and 3 wells subsequent to the evaluation of groundwater monitoring data from the investigation proposed in Section 3.1.

Final soil grid locations will be selected in consultation with EPA, and will be determined based on the MW-40 and MW-44 groundwater sampling results, the soil sampling results at MW-1S and MW-26/MW-59, results of the groundwater investigation proposed herein, and historical aerial photograph findings. Contaminant fate and transport modeling as proposed in the Fate and Transport Modeling Review and Recommendations letter (Odgen, 1999b) could prove useful in designing these soil sampling plans.

4.0 References

Ogden, 1999a. Response Plan for Demolition Area 1. Prepared for the National Guard Bureau, Arlington VA, by Ogden Environmental and Energy Services, Westford MA, July 13, 1999.

Ogden, 1999b. Correspondence from Jay Clausen (Ogden) to Jane Dolan (EPA) and Jan Drake (MADEP), Re: Fate and Transport Modeling Review and Recommendations, July 22, 1999.

Ogden, 1998. Workplan for Completion of Phase I Activities. Prepared for the National Guard Bureau, Arlington VA, by Ogden Environmental and Energy Services, Westford MA, August 20, 1998.

Table 1. Monitoring Well Screen Intervals and RDX Concentrations

	Screen Interval		Date	RDX	HMX	
Well ID	**(feet NGDV)**	**(feet bwt)**	**Sampled**	**(ug/L)**	**(ug/L)**	**Notes**
Group 1						
MW-26S	72 to 62	-3 to 7	02/04/98	ND	ND	
MW-26S	72 to 62	-3 to 7	03/17/99	0.49J	0.3	
MW-59S	75 to 65	-2 to 8	03/30/99	1.0	0.84	
MW-59S	75 to 65	-2 to 8	05/10/99	0.82J	0.81	
MW-59M2	53 to 43	20 to 30	03/31/99	ND	ND	
MW-59M1	38 to 33	35 to 40	03/31/99	ND	ND	
MW-2S	70 to 60	-2 to 8	02/23/98	ND	ND	
MW-2S	70 to 60	-2 to 8	02/01/99	ND	ND	
MW-2M2	37 to 32	31 to 36	01/20/98	13	ND	
MW-2M2	37 to 32	31 to 36	02/03/99	6.8	0.3J	
MW-2M1	-5 to -10	73 to 78	01/21/98	ND	ND	
MW-2M1	-5 to -10	73 to 78	02/03/99	ND	ND	
MW-2D	-148 to -153	216 to 221	11/19/97	ND	ND	
MW-2D	-148 to -153	216 to 221	02/02/99	ND	ND	
MW-41M3	69 to 59	-1 to 9	04/06/99	ND	ND	
MW-41M2	-1 to -11	69 to 79	04/02/99	ND	ND	
MW-41M1	-42 to -52	110 to 120	04/05/99	ND	ND	
MW-50S	64 to 54	-5 to 5	04/23/99	ND	ND	
MW-50M3	31 to 21	28 to 38	04/26/99	ND	ND	
MW-50M2	1 to -9	58 to 68	04/26/99	ND	ND	
MW-50M1	-29to -39	88 to 98	04/27/99	1.9J	ND	
MW-50D	-59 to -69	118 to 128	04/27/99	ND	ND	
MW-50D	-59 to -69	118 to 128	04/27/99	ND	ND	1
LRWS 95-6	-21 to -33	62 to 74	10/17/97	ND	ND	
LRWS 95-6B	-50 to -60	93 to 103	3/24/99	ND	ND	
Group 2						
MW-44S	74 to 64	-4 to 6	09/21/99	ND	ND	
MW-44M2	54 to 44	15 to 25	09/20/99	ND	ND	
MW-44M1	15 to 5	55 to 65	09/20/99	ND	ND	
MW-43S	69 to 59	-1 to 9	05/25/99	ND	ND	
MW-43M2	-2 to -12	70 to 80	05/26/99	.64J	ND	
MW-43M1	-25 to -35	93 to 103	05/26/99	ND	ND	
MW-23S	61 to 51	-2 to 8	10/27/97	ND	ND	
MW-23S	61 to 51	-2 to 8	03/12/99	ND	ND	
MW-23M3	27 to 22	32 to 37	11/13/97	ND	ND	
MW-23M3	27 to 22	32 to 37	11/13/97	ND	ND	1
MW-23M3	27 to 22	32 to 37	03/17/99	ND	ND	
MW-23M2	-6 to -11	65 to 70	11/11/97	ND	ND	
MW-23M2	-6 to -1	65 to 70	03/18/99	ND	ND	
MW-23M1	-42 to -52	101 to 111	11/07/99	2.3J	ND	
MW-23M1	-42 to –52	101 to 111	03/18/99	4.4	ND	
MW-23M1	-42 to -52	101 to 111	03/18/99	4.7	ND	1

Table 1. Monitoring Well Screen Intervals and RDX Concentrations

	Screen Interval		Date	RDX	HMX	
Well ID	**(feet NGDV)**	**(feet bwt)**	**Sampled**	**(ug/L)**	**(ug/L)**	**Notes**
MW-23D	-89 to -99	148 to 158	10/28/97	ND	ND	
MW-23D	-89 to -99	148 to 158	03/17/99	ND	ND	
MW-23D	-89 to -99	148 to 158	03/17/99	ND	ND	1
MW-42M3	-46 to -56	99 to 109	05/25/99	ND	ND	
MW-42M2	-66 to -76	119 to 129	05/24/99	ND	ND	
MW-42M1	-86 to -96	139 to 149	05/24/99	ND	ND	
MW-51S	61.71 to 51.71	-2 to 8	05/27/99	ND	ND	
MW-51M1	-29.24 to –39.24	89 to 99	04/27/99	ND	ND	
MW-51M2	1.72 to –8.28	58 to 68	04/27/99	ND	ND	
MW-51M3	31.71 to 21.71	28 to 38	04/28/99	ND	ND	
MW-51D	-59.25 to –69.25	119 to 129	04/27/99	ND	ND	
MW-72S	NA	-2 to 8	08/05/99	ND	ND	
Group 3						
MW-40S	73 to 63	-2 to 8	09/21/99	ND	ND	
MW-40M1	56 to 46	16 to 26	09/21/99	2.8	ND	
MW-40M1D	56 to 46	16 to 26	09/21/99	2.6	ND	
MW-37M1	8 to –2	64 to 74	09/28/99	ND	ND	
MW-37M2	45 to 35	28 to 38	09/28/99	1.1	ND	
MW-37M3	59 to 49	13 to 23	09/28/99	2.9	ND	
MW-1S	73 to 63	-2 to 8	09/30/97	2.5	0.59	
MW-1S	73 to 63	-2 to 8	09/30/97	2.4	0.53	1
MW-1S	73 to 63	-2 to 8	02/22/99	2.8	.63J	
MW-1M2	27 to 22	44 to 49	09/29/97	4.6	ND	
MW-1M2	27 to 22	44 to 49	03/01/99	2.2	ND	
MW-1M1	-33 to -38	104 to 109	01/19/98	ND	ND	
MW-1M1	-33 to -38	104 to 109	02/24/99	ND	ND	
MW-1M1	-33 to -38	104 to 109	02/24/99	ND	ND	1
MW-1D	-103 to -113	174 to 184	10/01/97	ND	ND	
MW-1D	-103 to -113	174 to 184	02/08/99	ND	ND	
MW-38S	72 to 62	-2 to 8	05/10/99	ND	ND	
MW-38M4	55 to 45	15 to 20	05/06/99	1.2	ND	
MW-38M3	17 to 7	53 to 63	05/06/99	2.5	ND	
MW-38M2	0 to -10	70 to 80	05/11/99	ND	ND	
MW-38M1	-30 to -40	100 to 110	05/07/99	ND	ND	
MW-38D	-55 to -65	125 to 135	05/12/99	ND	ND	
MW-39S	71 to 61	-2 to 8	05/21/99	ND	ND	
MW-39S	71 to 61	-2 to 8	05/21/99	ND	ND	1
MW-39M2	27 to 17	42 to 52	05/20/99	ND	0.7	
MW-39M1	-18 to -28	87 to 97	05/20/99	ND	ND	

NGVD - National Geodetic Vertical Datum
bwt - below water table
ug/L - micrograms per liter
ND - not detected

J - laboratory estimated value
1 - field duplicate sample
NS – not sampled
NA – not available

Table 2. Groundwater Profile Sample Results

SAMP ID	LOCID	DATE	SBD	SED	ANALYTE	CONC.	UNITS	FLAGS	PDA
G01DAA	MW-1	08/22/97	120	120	HMX	0.72	UG/L	NJ	
G01DAA	MW-1	08/22/97	120	120	RDX	2.9	UG/L		
G01DBA	MW-1	08/22/97	130	130	HMX	1.1	UG/L	NJ	
G01DBA	MW-1	08/22/97	130	130	RDX	5.6	UG/L	J	
G01DCA	MW-1	08/25/97	140	140	HMX	0.33	UG/L		
G01DCA	MW-1	08/25/97	140	140	RDX	0.95	UG/L	J	
G01DDA	MW-1	08/26/97	150	150	HMX	0.25	UG/L	U	
G01DDA	MW-1	08/26/97	150	150	RDX	0.25	UG/L	U	
G01DEA	MW-1	08/26/97	162	162	HMX	0.25	UG/L	U	
G01DEA	MW-1	08/26/97	162	162	RDX	5.9	UG/L		
G01DED	MW-1	08/26/97	162	162	HMX	0.25	UG/L	U	
G01DED	MW-1	08/26/97	162	162	RDX	7.6	UG/L		
G01DGA	MW-1	08/27/97	182	182	HMX	0.25	UG/L	U	
G01DGA	MW-1	08/27/97	182	182	RDX	0.25	UG/L	U	
G01DHA	MW-1	08/27/97	192	192	HMX	0.39	UG/L	U	
G01DHA	MW-1	08/27/97	192	192	RDX	0.39	UG/L	U	
G01DIA	MW-1	08/28/97	202	202	HMX	0.25	UG/L	U	
G01DIA	MW-1	08/28/97	202	202	RDX	0.25	UG/L	U	
G01DJA	MW-1	08/29/97	212	212	HMX	0.25	UG/L	UJ	
G01DJA	MW-1	08/29/97	212	212	RDX	0.25	UG/L	UJ	
G01DKA	MW-1	09/02/97	221	221	HMX	0.25	UG/L	U	
G01DKA	MW-1	09/02/97	221	221	RDX	0.25	UG/L	U	
G01DLA	MW-1	09/02/97	232	232	HMX	0.25	UG/L	U	
G01DLA	MW-1	09/02/97	232	232	RDX	0.25	UG/L	U	
G01DNA	MW-1	09/04/97	252	252	HMX	0.25	UG/L	U	
G01DNA	MW-1	09/04/97	252	252	RDX	0.25	UG/L	U	
G01DOA	MW-1	09/08/97	262	262	HMX	0.25	UG/L	U	
G01DOA	MW-1	09/08/97	262	262	RDX	0.25	UG/L	U	
G01DPA	MW-1	09/09/97	272	272	HMX	0.25	UG/L	U	
G01DPA	MW-1	09/09/97	272	272	RDX	0.25	UG/L	U	
G01DPD	MW-1	09/09/97	272	272	HMX	0.25	UG/L	U	
G01DPD	MW-1	09/09/97	272	272	RDX	0.25	UG/L	U	
G01DQA	MW-1	09/09/97	282	282	HMX	0.25	UG/L	U	
G01DQA	MW-1	09/09/97	282	282	RDX	0.25	UG/L	U	
G01DRA	MW-1	09/09/97	292	292	HMX	0.25	UG/L	U	
G01DRA	MW-1	09/09/97	292	292	RDX	0.25	UG/L	U	
G02DAA	MW-2	10/16/97	142	146	HMX	0.25	UG/L	U	
G02DAA	MW-2	10/16/97	142	146	RDX	0.25	UG/L	U	
G02DBA	MW-2	10/16/97	152	155	HMX	0.25	UG/L	U	
G02DBA	MW-2	10/16/97	152	155	RDX	0.25	UG/L	U	
G02DCA	MW-2	10/16/97	160	165	HMX	0.25	UG/L	U	
G02DCA	MW-2	10/16/97	160	165	RDX	0.25	UG/L	U	

Table 2. Groundwater Profile Sample Results

SAMP ID	LOCID	DATE	SBD	SED	ANALYTE	CONC.	UNITS	FLAGS	PDA
G02DDA	MW-2	10/16/97	170	175	HMX	0.25	UG/L	U	
G02DDA	MW-2	10/16/97	170	175	RDX	6.6	UG/L		
G02DEA	MW-2	10/17/97	182	186	HMX	0.25	UG/L	U	
G02DEA	MW-2	10/17/97	182	186	RDX	0.25	UG/L	U	
G02DFA	MW-2	10/17/97	192	196	HMX	0.25	UG/L	U	
G02DFA	MW-2	10/17/97	192	196	RDX	0.25	UG/L	U	
G02DGA	MW-2	10/17/97	202	206	HMX	0.25	UG/L	U	
G02DGA	MW-2	10/17/97	202	206	RDX	0.25	UG/L	U	
G02DHA	MW-2	10/20/97	212	216	HMX	0.25	UG/L	U	
G02DHA	MW-2	10/20/97	212	216	RDX	0.25	UG/L	U	
G02DIA	MW-2	10/20/97	222	226	HMX	0.25	UG/L	U	
G02DIA	MW-2	10/20/97	222	226	RDX	0.25	UG/L	U	
G02DJA	MW-2	10/20/97	232	236	HMX	0.25	UG/L	U	
G02DJA	MW-2	10/20/97	232	236	RDX	0.25	UG/L	U	
G02DKA	MW-2	10/20/97	242	246	HMX	0.25	UG/L	U	
G02DKA	MW-2	10/20/97	242	246	RDX	0.25	UG/L	U	
G02DKD	MW-2	10/20/97	242	246	HMX	0.25	UG/L	U	
G02DKD	MW-2	10/20/97	242	246	RDX	0.25	UG/L	U	
G02DLA	MW-2	10/20/97	252	256	HMX	0.25	UG/L	U	
G02DLA	MW-2	10/20/97	252	256	RDX	0.25	UG/L	U	
G02DMA	MW-2	10/21/97	262	266	HMX	0.25	UG/L	U	
G02DMA	MW-2	10/21/97	262	266	RDX	0.25	UG/L	U	
G02DNA	MW-2	10/21/97	272	276	HMX	0.25	UG/L	U	
G02DNA	MW-2	10/21/97	272	276	RDX	0.25	UG/L	U	
G02DOA	MW-2	10/21/97	282	286	HMX	0.25	UG/L	U	
G02DOA	MW-2	10/21/97	282	286	RDX	0.25	UG/L	U	
G02DPA	MW-2	10/21/97	292	296	HMX	0.25	UG/L	U	
G02DPA	MW-2	10/21/97	292	296	RDX	0.25	UG/L	U	
G02DQA	MW-2	10/22/97	302	306	HMX	0.25	UG/L	U	
G02DQA	MW-2	10/22/97	302	306	RDX	0.25	UG/L	U	
G02DRA	MW-2	10/22/97	312	316	HMX	0.25	UG/L	U	
G02DRA	MW-2	10/22/97	312	316	RDX	0.25	UG/L	U	
G02DSA	MW-2	10/22/97	322	326	HMX	0.25	UG/L	U	
G02DSA	MW-2	10/22/97	322	326	RDX	0.25	UG/L	U	
G02DTA	MW-2	10/22/97	332	336	HMX	0.25	UG/L	U	
G02DTA	MW-2	10/22/97	332	336	RDX	0.25	UG/L	U	
G02DUA	MW-2	10/23/97	342	346	HMX	0.25	UG/L	U	
G02DUA	MW-2	10/23/97	342	346	RDX	0.25	UG/L	U	
G02DVA	MW-2	10/23/97	352	356	HMX	0.25	UG/L	U	
G02DVA	MW-2	10/23/97	352	356	RDX	0.25	UG/L	U	
G23DAA	MW-23	07/22/97	143	146	HMX	10	UG/L	U	
G23DAA	MW-23	07/22/97	143	146	RDX	10	UG/L	U	

Table 2. Groundwater Profile Sample Results									
SAMP ID	LOCID	DATE	SBD	SED	ANALYTE	CONC.	UNITS	FLAGS	PDA
G23DBA	MW-23	07/22/97	152	155	HMX	10	UG/L	U	
G23DBA	MW-23	07/22/97	152	155	RDX	10	UG/L	U	
G23DCA	MW-23	07/23/97	163	166	HMX	10	UG/L	U	
G23DCA	MW-23	07/23/97	163	166	RDX	10	UG/L	U	
G23DDA	MW-23	07/23/97	173	176	HMX	10	UG/L	U	
G23DDA	MW-23	07/23/97	173	176	RDX	10	UG/L	U	
G23DEA	MW-23	07/23/97	183	186	HMX	10	UG/L	U	
G23DEA	MW-23	07/23/97	183	186	RDX	10	UG/L	U	
G23DFA	MW-23	07/23/97	193	196	HMX	10	UG/L	U	
G23DFA	MW-23	07/23/97	193	196	RDX	10	UG/L	U	
G23DGA	MW-23	07/23/97	203	206	HMX	10	UG/L	U	
G23DGA	MW-23	07/23/97	203	206	RDX	10	UG/L	U	
G23DHA	MW-23	07/23/97	212	215	HMX	10	UG/L	U	
G23DHA	MW-23	07/23/97	212	215	RDX	10	UG/L	U	
G23DHD	MW-23	07/23/97	212	215	HMX	10	UG/L	U	
G23DHD	MW-23	07/23/97	212	215	RDX	10	UG/L	U	
G23DIA	MW-23	07/24/97	223	226	HMX	10	UG/L	U	
G23DIA	MW-23	07/24/97	223	226	RDX	10	UG/L	U	
G23DJA	MW-23	07/24/97	233	236	HMX	10	UG/L	U	
G23DJA	MW-23	07/24/97	233	236	RDX	10	UG/L	U	
G23DKA	MW-23	07/24/97	243	246	HMX	10	UG/L	U	
G23DKA	MW-23	07/24/97	243	246	RDX	10	UG/L	U	
G23DLA	MW-23	07/24/97	253	256	HMX	10	UG/L	U	
G23DLA	MW-23	07/24/97	253	256	RDX	10	UG/L	U	
G23DMA	MW-23	07/24/97	263	266	HMX	10	UG/L	U	
G23DMA	MW-23	07/24/97	263	266	RDX	10	UG/L	U	
G23DNA	MW-23	07/28/97	273	276	HMX	10	UG/L	U	
G23DNA	MW-23	07/28/97	273	276	RDX	10	UG/L	U	
G23DOA	MW-23	07/28/97	293	296	HMX	10	UG/L	U	
G23DOA	MW-23	07/28/97	293	296	RDX	10	UG/L	U	
G27DAA	MW-27	10/07/97	130	130	HMX	0.25	UG/L	U	
G27DAA	MW-27	10/07/97	130	130	RDX	0.3	UG/L	J	
G37MAA	MW-37	03/31/99	125	125	RDX	0.25	UG/L	*	
G37MAA	MW-37	03/31/99	125	125	HMX	0.25	UG/L	*	
G37MBA	MW-37	03/31/99	135	135	RDX	4.05	UG/L	*	No
G37MBA	MW-37	03/31/99	135	135	HMX	0.34	UG/L	*	Yes
G37MCA	MW-37	03/31/99	145	145	RDX	5.19	UG/L	*	
G37MCA	MW-37	03/31/99	145	145	HMX	0.25	UG/L	*	
G37MCD	MW-37	03/31/99	145	145	RDX	4.65	UG/L	*	No
G37MCD	MW-37	03/31/99	145	145	HMX	0.25	UG/L	*	
G37MDA	MW-37	03/31/99	155	155	RDX	0.60	UG/L	*	No
G37MDA	MW-37	03/31/99	155	155	HMX	0.25	UG/L	*	

Table 2. Groundwater Profile Sample Results

SAMP ID	LOCID	DATE	SBD	SED	ANALYTE	CONC.	UNITS	FLAGS	PDA
G37MEA	MW-37	03/31/99	165	165	RDX	0.25	UG/L	*	
G37MEA	MW-37	03/31/99	165	165	HMX	0.25	UG/L	*	
G37MFA	MW-37	04/01/99	175	175	RDX	0.25	UG/L	*	
G37MFA	MW-37	04/01/99	175	175	HMX	0.25	UG/L	*	
G37MGA	MW-37	04/01/99	185	185	RDX	0.25	UG/L	*	
G37MGA	MW-37	04/01/99	185	185	HMX	0.25	UG/L	*	
G37MHA	MW-37	04/01/99	195	195	RDX	0.25	UG/L	*	
G37MHA	MW-37	04/01/99	195	195	HMX	0.25	UG/L	*	
G37MIA	MW-37	04/01/99	205	205	RDX	0.25	UG/L	*	
G37MIA	MW-37	04/01/99	205	205	HMX	0.25	UG/L	*	
G37MJA	MW-37	04/01/99	215	215	RDX	0.25	UG/L	*	
G37MJA	MW-37	04/01/99	215	215	HMX	0.25	UG/L	*	
G37MKA	MW-37	04/01/99	225	225	RDX	0.25	UG/L	*	
G37MKA	MW-37	04/01/99	225	225	HMX	0.25	UG/L	*	
G38MAA	MW-38	03/05/99	130	130	HMX	0.36	UG/L	*	NO
G38MAA	MW-38	03/05/99	130	130	RDX	3.8	UG/L	*	NO
G38MBA	MW-38	03/09/99	140	140	HMX	0.96	UG/L	*	NO
G38MBA	MW-38	03/09/99	140	140	RDX	1.1	UG/L	*	NO
G38MCA	MW-38	03/09/99	150	150	HMX	0.25	UG/L	U*	
G38MCA	MW-38	03/09/99	150	150	RDX	0.25	UG/L	U*	
G38MCD	MW-38	03/09/99	150	150	HMX	0.25	UG/L	U*	
G38MCD	MW-38	03/09/99	150	150	RDX	0.25	UG/L	U*	
G38MDA	MW-38	03/09/99	160	160	HMX	0.25	UG/L	U*	
G38MDA	MW-38	03/09/99	160	160	RDX	0.25	UG/L	U*	
G38MEA	MW-38	03/09/99	170	170	HMX	0.25	UG/L	U*	
G38MEA	MW-38	03/09/99	170	170	RDX	4.1	UG/L	*	NO
G38MFA	MW-38	03/09/99	180	180	HMX	0.25	UG/L	U*	
G38MFA	MW-38	03/09/99	180	180	RDX	2.2	UG/L	*	NO
G38MGA	MW-38	03/10/99	190	190	HMX	0.25	UG/L	U*	
G38MGA	MW-38	03/10/99	190	190	RDX	0.25	UG/L	U*	
G38MHA	MW-38	03/10/99	200	200	HMX	0.25	UG/L	U*	
G38MHA	MW-38	03/10/99	200	200	RDX	0.25	UG/L	U*	
G38MHD	MW-38	03/10/99	200	200	HMX	0.25	UG/L	U*	
G38MHD	MW-38	03/10/99	200	200	RDX	0.25	UG/L	U*	
G38MIA	MW-38	03/11/99	210	210	HMX	0.25	UG/L	U*	
G38MIA	MW-38	03/11/99	210	210	RDX	0.25	UG/L	U*	
G38MJA	MW-38	03/11/99	220	220	HMX	0.25	UG/L	U*	
G38MJA	MW-38	03/11/99	220	220	RDX	0.25	UG/L	U*	
G38MKA	MW-38	03/11/99	230	230	HMX	0.25	UG/L	U*	
G38MKA	MW-38	03/11/99	230	230	RDX	0.25	UG/L	U*	
G38MLA	MW-38	03/11/99	240	240	HMX	0.25	UG/L	U*	
G38MLA	MW-38	03/11/99	240	240	RDX	0.25	UG/L	U*	

Table 2. Groundwater Profile Sample Results

SAMP ID	LOCID	DATE	SBD	SED	ANALYTE	CONC.	UNITS	FLAGS	PDA
G38MMA	MW-38	03/12/99	250	250	HMX	0.25	UG/L	U*	
G38MMA	MW-38	03/12/99	250	250	RDX	0.25	UG/L	U*	
G38MNA	MW-38	03/12/99	260	260	HMX	0.25	UG/L	U*	
G38MNA	MW-38	03/12/99	260	260	RDX	0.25	UG/L	U*	
G38MOA	MW-38	03/17/99	270	270	HMX	0.25	UG/L	U*	
G38MOA	MW-38	03/17/99	270	270	RDX	0.25	UG/L	U*	
G38MPA	MW-38	03/17/99	274	274	HMX	0.25	UG/L	U*	
G38MPA	MW-38	03/17/99	274	274	RDX	0.25	UG/L	U*	
G38MPD	MW-38	03/17/99	274	274	HMX	0.25	UG/L	U*	
G38MPD	MW-38	03/17/99	274	274	RDX	0.25	UG/L	U*	
G39MAA	MW-39	03/22/99	140	140	HMX	0.25	UG/L	U*	
G39MAA	MW-39	03/22/99	140	140	RDX	0.25	UG/L	U*	
G39MBA	MW-39	03/24/99	150	150	HMX	0.25	UG/L	U*	
G39MBA	MW-39	03/24/99	150	150	RDX	0.25	UG/L	U*	
G39MCA	MW-39	03/24/99	160	160	HMX	0.25	UG/L	U*	
G39MCA	MW-39	03/24/99	160	160	RDX	0.57	UG/L	*	NO
G39MDA	MW-39	03/25/99	170	170	HMX	0.25	UG/L	U*	
G39MDA	MW-39	03/25/99	170	170	RDX	1.5	UG/L	*	NO
G39MDD	MW-39	03/25/99	170	170	HMX	0.25	UG/L	U*	
G39MDD	MW-39	03/25/99	170	170	RDX	0.79	UG/L	*	NO
G39MEA	MW-39	03/25/99	180	180	HMX	0.4	UG/L	*	YES
G39MEA	MW-39	03/25/99	180	180	RDX	0.39	UG/L	*	NO
G39MFA	MW-39	03/25/99	190	190	HMX	0.25	UG/L	U*	
G39MFA	MW-39	03/25/99	190	190	RDX	0.25	UG/L	U*	
G39MGA	MW-39	03/25/99	200	200	HMX	0.25	UG/L	U*	
G39MGA	MW-39	03/25/99	200	200	RDX	0.25	UG/L	U*	
G39MHA	MW-39	03/25/99	210	210	HMX	0.25	UG/L	U*	
G39MHA	MW-39	03/25/99	210	210	RDX	0.25	UG/L	U*	
G39MIA	MW-39	03/25/99	220	220	HMX	0.25	UG/L	U*	
G39MIA	MW-39	03/25/99	220	220	RDX	1.5	UG/L	*	NO
G39MID	MW-39	03/25/99	220	220	HMX	0.25	UG/L	U*	
G39MID	MW-39	03/25/99	220	220	RDX	2.1	UG/L	*	NO
G39MJA	MW-39	03/25/99	230	230	HMX	0.25	UG/L	U*	
G39MJA	MW-39	03/25/99	230	230	RDX	0.62	UG/L	*	NO
G39MKA	MW-39	03/26/99	240	240	HMX	0.25	UG/L	U*	
G39MKA	MW-39	03/26/99	240	240	RDX	0.25	UG/L	U*	
G39MLA	MW-39	03/26/99	250	250	HMX	0.25	UG/L	U*	
G39MLA	MW-39	03/26/99	250	250	RDX	0.25	UG/L	U*	
G39MMA	MW-39	03/26/99	260	260	HMX	0.25	UG/L	U*	
G39MMA	MW-39	03/26/99	260	260	RDX	0.7	UG/L	*	NO
G39MNA	MW-39	03/26/99	270	270	HMX	0.25	UG/L	U*	
G39MNA	MW-39	03/26/99	270	270	RDX	0.25	UG/L	U*	

Table 2. Groundwater Profile Sample Results

SAMP ID	LOCID	DATE	SBD	SED	ANALYTE	CONC.	UNITS	FLAGS	PDA
G39MOA	MW-39	03/26/99	282.5	282.5	HMX	0.25	UG/L	U*	
G39MOA	MW-39	03/26/99	282.5	282.5	RDX	0.25	UG/L	U*	
G40MAA	MW-40	04/05/99	132	132	HMX	0.25	UG/L	U*	
G40MAA	MW-40	04/05/99	132	132	RDX	1	UG/L	*	NO
G40MBA	MW-40	04/06/99	142	142	HMX	0.25	UG/L	U*	
G40MBA	MW-40	04/06/99	142	142	RDX	0.25	UG/L	U*	
G40MBD	MW-40	04/06/99	142	142	HMX	0.25	UG/L	U*	
G40MBD	MW-40	04/06/99	142	142	RDX	0.25	UG/L	U*	
G40MCA	MW-40	04/06/99	152	152	HMX	0.25	UG/L	U*	
G40MCA	MW-40	04/06/99	152	152	RDX	0.25	UG/L	U*	
G40MDA	MW-40	04/06/99	162	162	HMX	0.25	UG/L	U*	
G40MDA	MW-40	04/06/99	162	162	RDX	0.25	UG/L	U*	
G40MEA	MW-40	04/06/99	172	172	HMX	0.25	UG/L	U*	
G40MEA	MW-40	04/06/99	172	172	RDX	0.25	UG/L	U*	
G40MFA	MW-40	04/06/99	182	182	HMX	0.25	UG/L	U*	
G40MFA	MW-40	04/06/99	182	182	RDX	0.25	UG/L	U*	
G40MGA	MW-40	04/06/99	192	192	HMX	0.25	UG/L	U*	
G40MGA	MW-40	04/06/99	192	192	RDX	0.25	UG/L	U*	
G40MHA	MW-40	04/06/99	202	202	HMX	0.25	UG/L	U*	
G40MHA	MW-40	04/06/99	202	202	RDX	0.25	UG/L	U*	
G40MHD	MW-40	04/06/99	202	202	HMX	0.25	UG/L	U*	
G40MHD	MW-40	04/06/99	202	202	RDX	0.25	UG/L	U*	
G40MIA	MW-40	04/06/99	212	212	HMX	0.25	UG/L	U*	
G40MIA	MW-40	04/06/99	212	212	RDX	0.25	UG/L	U*	
G40MJA	MW-40	04/07/99	222	222	HMX	0.25	UG/L	U*	
G40MJA	MW-40	04/07/99	222	222	RDX	0.69	UG/L	*	NO
G41MAA	MW-41	02/11/99	135	135	HMX	0.25	UG/L	U	
G41MAA	MW-41	02/11/99	135	135	RDX	0.25	UG/L	U	
G41MAD	MW-41	02/11/99	135	135	HMX	0.25	UG/L	U	
G41MAD	MW-41	02/11/99	135	135	RDX	0.25	UG/L	U	
G41MBA	MW-41	02/11/99	141	141	HMX	0.25	UG/L	U	
G41MBA	MW-41	02/11/99	141	141	RDX	0.25	UG/L	U	
G41MCA	MW-41	02/12/99	151	151	HMX	0.25	UG/L	U	
G41MCA	MW-41	02/12/99	151	151	RDX	0.25	UG/L	U	
G41MDA	MW-41	02/12/99	161	161	HMX	0.25	UG/L	U	
G41MDA	MW-41	02/12/99	161	161	RDX	0.25	UG/L	U	
G41MEA	MW-41	02/12/99	171	171	HMX	0.25	UG/L	U	
G41MEA	MW-41	02/12/99	171	171	RDX	0.25	UG/L	U	
G41MFA	MW-41	02/12/99	181	181	HMX	0.25	UG/L	U	
G41MFA	MW-41	02/12/99	181	181	RDX	0.25	UG/L	U	
G41MGA	MW-41	02/16/99	191	191	HMX	0.25	UG/L	U	
G41MGA	MW-41	02/16/99	191	191	RDX	0.25	UG/L	U	

Table 2. Groundwater Profile Sample Results

SAMP ID	LOCID	DATE	SBD	SED	ANALYTE	CONC.	UNITS	FLAGS	PDA
G41MHA	MW-41	02/16/99	201	201	HMX	0.25	UG/L	U	
G41MHA	MW-41	02/16/99	201	201	RDX	0.25	UG/L	U	
G41MHD	MW-41	02/16/99	201	201	HMX	0.25	UG/L	U	
G41MHD	MW-41	02/16/99	201	201	RDX	0.25	UG/L	U	
G41MIA	MW-41	02/16/99	211	211	HMX	0.25	UG/L	U	
G41MIA	MW-41	02/16/99	211	211	RDX	0.25	UG/L	U	
G41MJA	MW-41	02/16/99	221	221	HMX	0.25	UG/L	U	
G41MJA	MW-41	02/16/99	221	221	RDX	0.25	UG/L	U	
G41MKA	MW-41	02/16/99	231	231	HMX	0.25	UG/L	U	
G41MKA	MW-41	02/16/99	231	231	RDX	0.55	UG/L	U	
G41MLA	MW-41	02/17/99	241	241	HMX	0.25	UG/L	U	
G41MLA	MW-41	02/17/99	241	241	RDX	0.9	UG/L	U	
G41MMA	MW-41	02/17/99	253	253	HMX	0.25	UG/L	U	
G41MMA	MW-41	02/17/99	253	253	RDX	0.25	UG/L	U	
G42MAA	MW-42	02/12/99	80	80	HMX	0.25	UG/L	U	
G42MAA	MW-42	02/12/99	80	80	RDX	0.25	UG/L	U	
G42MBA	MW-42	02/12/99	90	90	HMX	0.25	UG/L	U	
G42MBA	MW-42	02/12/99	90	90	RDX	0.25	UG/L	U	
G42MCA	MW-42	02/12/99	100	100	HMX	0.25	UG/L	U	
G42MCA	MW-42	02/12/99	100	100	RDX	0.25	UG/L	U	
G42MDA	MW-42	02/12/99	110	110	HMX	0.25	UG/L	U	
G42MDA	MW-42	02/12/99	110	110	RDX	0.25	UG/L	U	
G42MEA	MW-42	02/12/99	120	120	HMX	0.25	UG/L	U	
G42MEA	MW-42	02/12/99	120	120	RDX	0.25	UG/L	U	
G42MFA	MW-42	02/12/99	130	130	HMX	0.25	UG/L	U	
G42MFA	MW-42	02/12/99	130	130	RDX	0.25	UG/L	U	
G42MFD	MW-42	02/12/99	130	130	HMX	0.25	UG/L	U	
G42MFD	MW-42	02/12/99	130	130	RDX	0.25	UG/L	U	
G42MGA	MW-42	02/12/99	140	140	HMX	0.25	UG/L	U	
G42MGA	MW-42	02/12/99	140	140	RDX	0.25	UG/L	U	
G42MHA	MW-42	02/12/99	150	150	HMX	0.25	UG/L	U	
G42MHA	MW-42	02/12/99	150	150	RDX	0.25	UG/L	U	
G42MIA	MW-42	02/16/99	160	160	HMX	0.25	UG/L	U	
G42MIA	MW-42	02/16/99	160	160	RDX	0.25	UG/L	U	
G42MJA	MW-42	02/16/99	170	170	HMX	0.25	UG/L	U	
G42MJA	MW-42	02/16/99	170	170	RDX	0.25	UG/L	U	
G42MKA	MW-42	02/17/99	180	180	HMX	0.25	UG/L	U	
G42MKA	MW-42	02/17/99	180	180	RDX	0.25	UG/L	U	
G42MLA	MW-42	02/17/99	190	190	HMX	0.25	UG/L	U	
G42MLA	MW-42	02/17/99	190	190	RDX	0.25	UG/L	U	
G42MMA	MW-42	02/17/99	200	200	HMX	0.25	UG/L	U	
G42MMA	MW-42	02/17/99	200	200	RDX	0.25	UG/L	U	

Table 2. Groundwater Profile Sample Results

SAMP ID	LOCID	DATE	SBD	SED	ANALYTE	CONC.	UNITS	FLAGS	PDA
G42MNA	MW-42	02/17/99	210	210	HMX	0.25	UG/L	U	
G42MNA	MW-42	02/17/99	210	210	RDX	0.25	UG/L	U	
G42MOA	MW-42	02/17/99	220	220	HMX	0.25	UG/L	U	
G42MOA	MW-42	02/17/99	220	220	RDX	0.25	UG/L	U	
G42MPA	MW-42	02/17/99	230	230	HMX	0.25	UG/L	U	
G42MPA	MW-42	02/17/99	230	230	RDX	0.25	UG/L	U	
G43MAA	MW-43	02/04/99	130	130	HMX	0.25	UG/L	U	
G43MAA	MW-43	02/04/99	130	130	RDX	0.25	UG/L	U	
G43MAD	MW-43	02/04/99	130	130	HMX	0.25	UG/L	U	
G43MAD	MW-43	02/04/99	130	130	RDX	0.25	UG/L	U	
G43MBA	MW-43	02/04/99	145	145	HMX	0.25	UG/L	U	
G43MBA	MW-43	02/04/99	145	145	RDX	0.25	UG/L	U	
G43MCA	MW-43	02/04/99	155	155	HMX	0.25	UG/L	U	
G43MCA	MW-43	02/04/99	155	155	RDX	0.25	UG/L	U	
G43MDA	MW-43	02/05/99	165	165	HMX	0.25	UG/L	U	
G43MDA	MW-43	02/05/99	165	165	RDX	0.25	UG/L	U	
G43MEA	MW-43	02/05/99	175	175	HMX	0.25	UG/L	U	
G43MEA	MW-43	02/05/99	175	175	RDX	0.25	UG/L	U	
G43MFA	MW-43	02/08/99	185	185	HMX	0.25	UG/L	U	
G43MFA	MW-43	02/08/99	185	185	RDX	0.25	UG/L	U	
G43MGA	MW-43	02/08/99	195	195	HMX	0.25	UG/L	U	
G43MGA	MW-43	02/08/99	195	195	RDX	0.5	UG/L	U	NO
G43MHA	MW-43	02/08/99	205	205	HMX	0.25	UG/L	U	
G43MHA	MW-43	02/08/99	205	205	RDX	0.25	UG/L	U	NO
G43MIA	MW-43	02/08/99	215	215	HMX	0.25	UG/L	U	
G43MIA	MW-43	02/08/99	215	215	RDX	0.28	UG/L	U	NO
G43MJA	MW-43	02/09/99	225	225	HMX	0.25	UG/L	U	
G43MJA	MW-43	02/09/99	225	225	RDX	0.25	UG/L	U	
G43MKA	MW-43	02/09/99	235	235	HMX	0.25	UG/L	U	
G43MKA	MW-43	02/09/99	235	235	RDX	0.25	UG/L	U	
G43MLA	MW-43	02/09/99	245	245	HMX	0.25	UG/L	U	
G43MLA	MW-43	02/09/99	245	245	RDX	0.25	UG/L	U	
G43MMA	MW-43	02/09/99	255	255	HMX	0.25	UG/L	U	
G43MMA	MW-43	02/09/99	255	255	RDX	0.25	UG/L	U	
G43MNA	MW-43	02/09/99	265	265	HMX	0.25	UG/L	U	
G43MNA	MW-43	02/09/99	265	265	RDX	0.25	UG/L	U	
G43MOA	MW-43	02/09/99	275	275	HMX	0.25	UG/L	U	
G43MOA	MW-43	02/09/99	275	275	RDX	0.25	UG/L	U	
G44MAA	MW-44	04/12/99	137.6	137.6	HMX	0.25	UG/L	U*	
G44MAA	MW-44	04/12/99	137.6	137.6	RDX	0.25	UG/L	U*	
G44MBA	MW-44	04/12/99	147.6	147.6	HMX	0.25	UG/L	U*	
G44MBA	MW-44	04/12/99	147.6	147.6	RDX	0.25	UG/L	U*	

Table 2. Groundwater Profile Sample Results

SAMP ID	LOCID	DATE	SBD	SED	ANALYTE	CONC.	UNITS	FLAGS	PDA
G44MBD	MW-44	04/12/99	147.6	147.6	HMX	0.25	UG/L	U*	
G44MBD	MW-44	04/12/99	147.6	147.6	RDX	0.25	UG/L	U*	
G44MCA	MW-44	04/13/99	157.5	157.5	HMX	0.25	UG/L	U*	
G44MCA	MW-44	04/13/99	157.5	157.5	RDX	0.25	UG/L	U*	
G44MDA	MW-44	04/13/99	167.5	167.5	HMX	0.25	UG/L	U*	
G44MDA	MW-44	04/13/99	167.5	167.5	RDX	0.31	UG/L	*	NO
G44MEA	MW-44	04/13/99	177.5	177.5	HMX	0.25	UG/L	U*	
G44MEA	MW-44	04/13/99	177.5	177.5	RDX	0.25	UG/L	U*	
G44MFA	MW-44	04/13/99	187.5	187.5	HMX	0.25	UG/L	U*	
G44MFA	MW-44	04/13/99	187.5	187.5	RDX	0.25	UG/L	U*	
G44MGA	MW-44	04/13/99	197.5	197.5	HMX	0.25	UG/L	U*	
G44MGA	MW-44	04/13/99	197.5	197.5	RDX	0.25	UG/L	U*	
G44MHA	MW-44	04/13/99	207.5	207.5	HMX	0.25	UG/L	U*	
G44MHA	MW-44	04/13/99	207.5	207.5	RDX	0.25	UG/L	U*	
G44MIA	MW-44	04/13/99	217.5	217.5	HMX	0.25	UG/L	U*	
G44MIA	MW-44	04/13/99	217.5	217.5	RDX	0.25	UG/L	U*	
G44MJA	MW-44	04/14/99	227.5	227.5	HMX	0.25	UG/L	U*	
G44MJA	MW-44	04/14/99	227.5	227.5	RDX	0.25	UG/L	U*	
G44MKA	MW-44	04/14/99	237.5	237.5	HMX	0.25	UG/L	U*	
G44MKA	MW-44	04/14/99	237.5	237.5	RDX	0.25	UG/L	U*	
G50DAA	MW-50	02/01/99	123	123	HMX	0.25	UG/L	U	
G50DAA	MW-50	02/01/99	123	123	RDX	0.25	UG/L	U	
G50DBA	MW-50	02/01/99	130	135	HMX	0.25	UG/L	U	
G50DBA	MW-50	02/01/99	130	135	RDX	0.25	UG/L	U	
G50DBD	MW-50	02/01/99	130	135	HMX	0.25	UG/L	U	
G50DBD	MW-50	02/01/99	130	135	RDX	0.25	UG/L	U	
G50DCA	MW-50	02/02/99	140	145	HMX	0.25	UG/L	U	
G50DCA	MW-50	02/02/99	140	145	RDX	0.25	UG/L	U	
G50DDA	MW-50	02/02/99	150	155	HMX	0.25	UG/L	U	
G50DDA	MW-50	02/02/99	150	155	RDX	0.25	UG/L	U	
G50DEA	MW-50	02/02/99	160	165	HMX	0.25	UG/L	U	
G50DEA	MW-50	02/02/99	160	165	RDX	0.25	UG/L	U	
G50DFA	MW-50	02/02/99	170	175	HMX	0.25	UG/L	U	
G50DFA	MW-50	02/02/99	170	175	RDX	0.25	UG/L	U	
G50DGA	MW-50	02/02/99	180	185	HMX	0.25	UG/L	U	
G50DGA	MW-50	02/02/99	180	185	RDX	0.25	UG/L	U	
G50DHA	MW-50	02/03/99	190	195	HMX	0.25	UG/L	U	
G50DHA	MW-50	02/03/99	190	195	RDX	0.25	UG/L	U	
G50DIA	MW-50	02/03/99	200	205	HMX	0.25	UG/L	U	
G50DIA	MW-50	02/03/99	200	205	RDX	2.8	UG/L		YES
G50DJA	MW-50	02/03/99	210	215	HMX	0.25	UG/L	U	
G50DJA	MW-50	02/03/99	210	215	RDX	4.8	UG/L		YES

Table 2. Groundwater Profile Sample Results

SAMP ID	LOCID	DATE	SBD	SED	ANALYTE	CONC.	UNITS	FLAGS	PDA
G50DKA	MW-50	02/03/99	220	225	HMX	0.25	UG/L	U	
G50DKA	MW-50	02/03/99	220	225	RDX	3.9	UG/L		YES
G50DLA	MW-50	02/03/99	230	235	HMX	0.25	UG/L	U	
G50DLA	MW-50	02/03/99	230	235	RDX	0.25	UG/L	U	
G50DMA	MW-50	02/04/99	240	245	HMX	0.25	UG/L	U	
G50DMA	MW-50	02/04/99	240	245	RDX	0.25	UG/L	U	
G50DNA	MW-50	02/04/99	250	255	HMX	0.25	UG/L	U	
G50DNA	MW-50	02/04/99	250	255	RDX	0.25	UG/L	U	
G50DOA	MW-50	02/04/99	260	265	HMX	0.25	UG/L	U	
G50DOA	MW-50	02/04/99	260	265	RDX	0.25	UG/L	U	
G50DPA	MW-50	02/04/99	270	275	HMX	0.25	UG/L	U	
G50DPA	MW-50	02/04/99	270	275	RDX	0.25	UG/L	U	
G50DQA	MW-50	02/05/99	280	285	HMX	0.25	UG/L	U	
G50DQA	MW-50	02/05/99	280	285	RDX	0.25	UG/L	U	
G50DRA	MW-50	02/05/99	290	295	HMX	0.25	UG/L	U	
G50DRA	MW-50	02/05/99	290	295	RDX	0.25	UG/L	U	
G50DRD	MW-50	02/05/99	290	295	HMX	0.25	UG/L	U	
G50DRD	MW-50	02/05/99	290	295	RDX	0.25	UG/L	U	
G50DSA	MW-50	02/05/99	300	305	HMX	0.25	UG/L	U	
G50DSA	MW-50	02/05/99	300	305	RDX	0.25	UG/L	U	
G59MAA	MW-59	02/22/99	135	135	HMX	0.62	UG/L	J	YES
G59MAA	MW-59	02/22/99	135	135	RDX	0.6	UG/L	U	NO
G59MBD	MW-59	02/23/99	146	146	HMX	0.25	UG/L	U	NO
G59MBD	MW-59	02/23/99	146	146	RDX	0.25	UG/L	U	NO
G59MBA	MW-59	02/23/99	146	146	HMX	0.25	UG/L	U	
G59MBA	MW-59	02/23/99	146	146	RDX	0.25	UG/L	U	
G59MCA	MW-59	02/23/99	156	156	HMX	0.25	UG/L	U	
G59MCA	MW-59	02/23/99	156	156	RDX	0.25	UG/L	U	
G59MDA	MW-59	02/23/99	166	166	HMX	0.25	UG/L	U	
G59MDA	MW-59	02/23/99	166	166	RDX	0.25	UG/L	U	
G59MEA	MW-59	02/23/99	176	176	HMX	0.25	UG/L	U	
G59MEA	MW-59	02/23/99	176	176	RDX	0.25	UG/L	U	
G59MFA	MW-59	02/23/99	186	186	HMX	0.25	UG/L	U	
G59MFA	MW-59	02/23/99	186	186	RDX	0.25	UG/L	U	
G59MGA	MW-59	02/23/99	196	196	HMX	0.25	UG/L	U	
G59MGA	MW-59	02/23/99	196	196	RDX	0.25	UG/L	U	
G59MGD	MW-59	02/23/99	196	196	HMX	0.25	UG/L	U	
G59MGD	MW-59	02/23/99	196	196	RDX	0.25	UG/L	U	
G59MHA	MW-59	02/23/99	206	206	HMX	0.25	UG/L	U	
G59MHA	MW-59	02/23/99	206	206	RDX	0.25	UG/L	U	
G59MIA	MW-59	02/23/99	216	216	HMX	0.25	UG/L	U	
G59MIA	MW-59	02/23/99	216	216	RDX	0.25	UG/L	U	

Table 2. Groundwater Profile Sample Results

SAMP ID	LOCID	DATE	SBD	SED	ANALYTE	CONC.	UNITS	FLAGS	PDA
G59MJA	MW-59	02/23/99	226	226	HMX	0.25	UG/L	U	
G59MJA	MW-59	02/23/99	226	226	RDX	0.25	UG/L	U	

SBD = Sample Begin Depth, measured in feet below ground surface
SED = Sample End Depth, measured in feet below ground surface
FLAGS = Data Qualifier Flags:

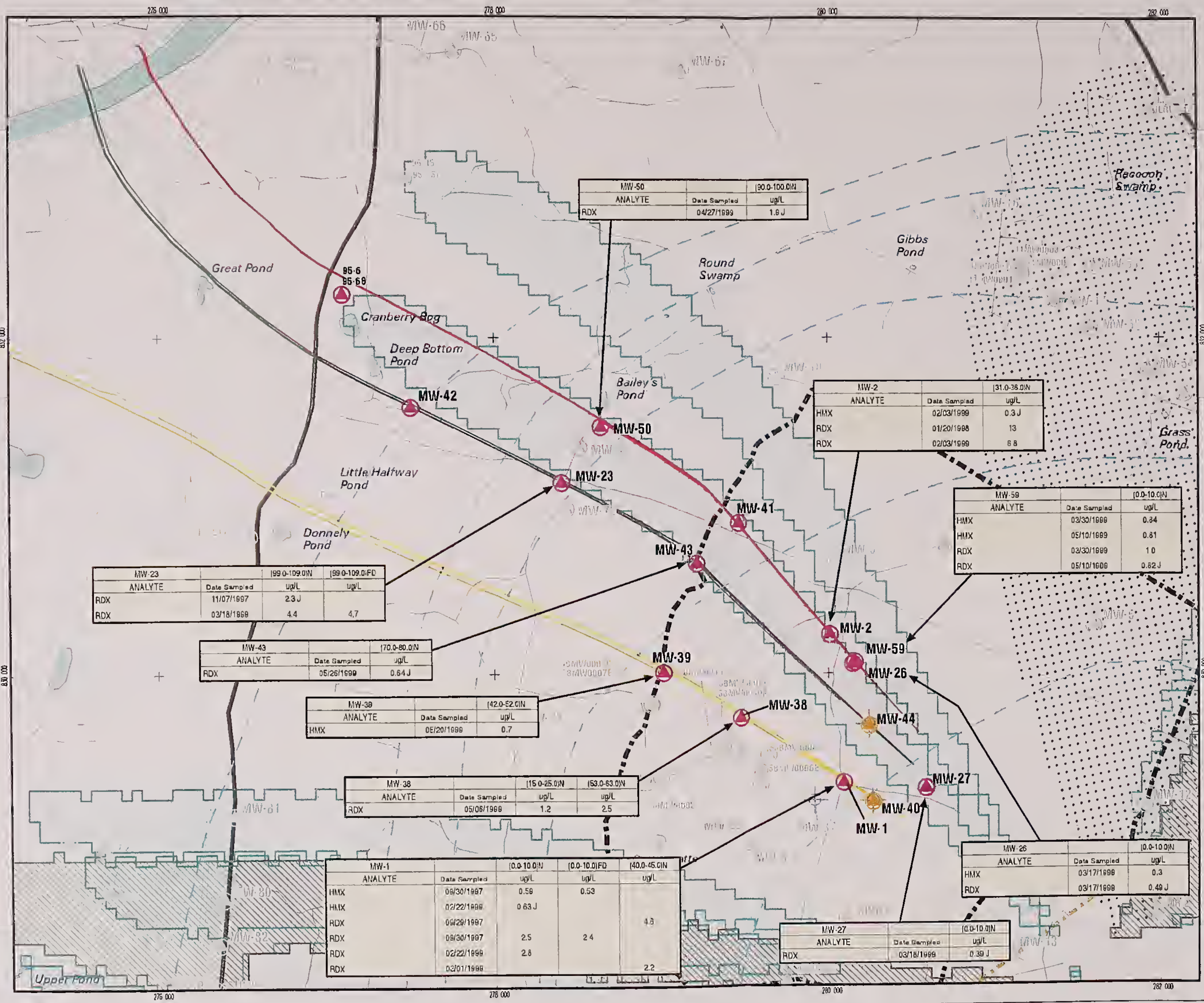
U	Non-detect
J	Estimated value
UJ	Non-detect, estimated reporting limit
NJ	Tentatively identified, estimated value
*	Result not validated

PDA = Photo Diode Array:

YES	Detect confirmed by PDA spectral review
NO	Detect not confirmed by PDA spectral review

Table 3. Proposed Groundwater Monitoring Well Details

Well ID	Proposed Soil Boring Depth (ft)	Well Group	Location Relative to Flow Path	Number of Monitoring Wells	Depth Ranges for Proposed Screen Intervals (ft bwt)
Inner (upgradient) Transect Wells					
P-1	80	1	Cross-gradient	2	0 to 10; 25 to 45
P-2	80	1	Cross-gradient	2	0 to 10; 25 to 45
P-3	80	2	Cross-gradient	2	0 to 10; 25 to 45
P-4	80	2	On path	2	0 to 10; 25 to 45
P-5	80	2	Cross-gradient	2	0 to 10; 25 to 45
P-6	80	2	Cross-gradient	2	0 to 10; 25 to 45
P-7	80	3	Cross-gradient	2	0 to 10; 25 to 45
P-8	80	3	Cross-gradient	2	0 to 10; 25 to 45
P-9	80	3	Cross-gradient	2	0 to 10; 25 to 45
Outer (downgradient) Transect Wells					
P-10	100	1	Cross-gradient	3	0 to 10; 25 to 45; 65 to 85
P-11	100	1	Cross-gradient	3	0 to 10; 25 to 45; 65 to 85
P-12	100	2	Cross-gradient	3	0 to 10; 25 to 45; 65 to 85
P-13	100	2	Cross-gradient	3	0 to 10; 25 to 45; 65 to 85
P-14	100	2	Cross-gradient	3	0 to 10; 25 to 45; 65 to 85
P-15	100	3	Cross-gradient	3	0 to 10; 25 to 45; 65 to 85
P-16	100	3	Cross-gradient	3	0 to 10; 25 to 45; 65 to 85
P-17	100	3	Cross-gradient	3	
Upgradient Wells					
P-18	50	1	Up-gradient	2	0 to 10; 25 to 45
P-19	50	2	Up-gradient	2	0 to 10; 25 to 45
P-20	50	3	Up-gradient	2	0 to 10; 25 to 45
Downgradient Wells					
P-21	150	3	Down-gradient	5	0 to 10; 30 to 40; 60 to 70; 90 to 100; 120 to 140



MW-50		[90.0-100.0]N
ANALYTE	Date Sampled	ug/L
RDX	04/27/1999	1.9 J

MW-2		[31.0-38.0]N
ANALYTE	Date Sampled	ug/L
HMX	02/03/1999	0.3 J
RDX	01/20/1998	13
RDX	02/03/1999	6.8

MW-59		[0.0-10.0]N
ANALYTE	Date Sampled	ug/L
HMX	03/30/1999	0.84
HMX	05/10/1999	0.81
RDX	03/30/1999	1.0
RDX	05/10/1999	0.82 J

MW-23		[99.0-109.0]N	[99.0-109.0]FD
ANALYTE	Date Sampled	ug/L	ug/L
RDX	11/07/1997	2.3 J	
RDX	03/18/1999	4.4	4.7

MW-43		[70.0-80.0]N
ANALYTE	Date Sampled	ug/L
RDX	05/26/1999	0.64 J

MW-39		[42.0-52.0]N
ANALYTE	Date Sampled	ug/L
HMX	05/20/1999	0.7

MW-38		[15.0-25.0]N	[53.0-63.0]N
ANALYTE	Date Sampled	ug/L	ug/L
RDX	05/06/1999	1.2	2.5

MW-1		[0.0-10.0]N	[0.0-10.0]FD	[40.0-45.0]N
ANALYTE	Date Sampled	ug/L	ug/L	ug/L
HMX	09/30/1997	0.59	0.53	
HMX	02/22/1999	0.63 J		
RDX	09/29/1997			4.6
RDX	09/30/1997	2.5	2.4	
RDX	02/22/1999	2.8		
RDX	03/01/1999			2.2

MW-26		[0.0-10.0]N
ANALYTE	Date Sampled	ug/L
HMX	03/17/1999	0.3
RDX	03/17/1999	0.49 J

MW-27		[0.0-10.0]N
ANALYTE	Date Sampled	ug/L
RDX	03/18/1999	0.39 J

MMR Groundwater Study

LEGEND

- ▲ Groundwater Wells
- ⊕ Wells Not Sampled
- ▲ Well Results Not Available as of 6/30/99
- △ Remaining Wells

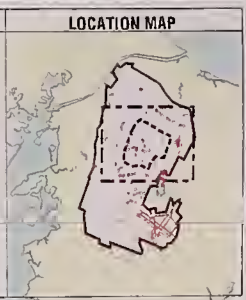
ug/L	Micrograms Per Liter
J	Estimated Quantity
FD	Field Duplicate
N	Normal Environmental Sample

All sample depth measurements are in feet

BASEMAP LEGEND

- Group 1 Particle Tracks
- Group 2 Particle Tracks
- Group 3 Particle Tracks
- Impact Area Boundary
- MMR Boundary
- Water Bodies
- Roads
- Groundwater Contours

LOCATION MAP



NOTES & SOURCES

Map coordinates: Stateplane, NAD83, Zone 4151, Meters

TITLE

CONCENTRATIONS OF RDX AND HMX IN GROUP 1, 2 AND 3 GROUNDWATER WELLS

0 2000
FEET
0 610
METERS

DATE	REV.	DRWN.	INIT.	CHKD.	INIT.	APPR.	INIT.
11/23/99							

FIGURE

1

DRAFT

/oahu/mmrdata/mmr/spatial/ogden/amls/plotexceptions/impactarea.aml map MMR1075_edit

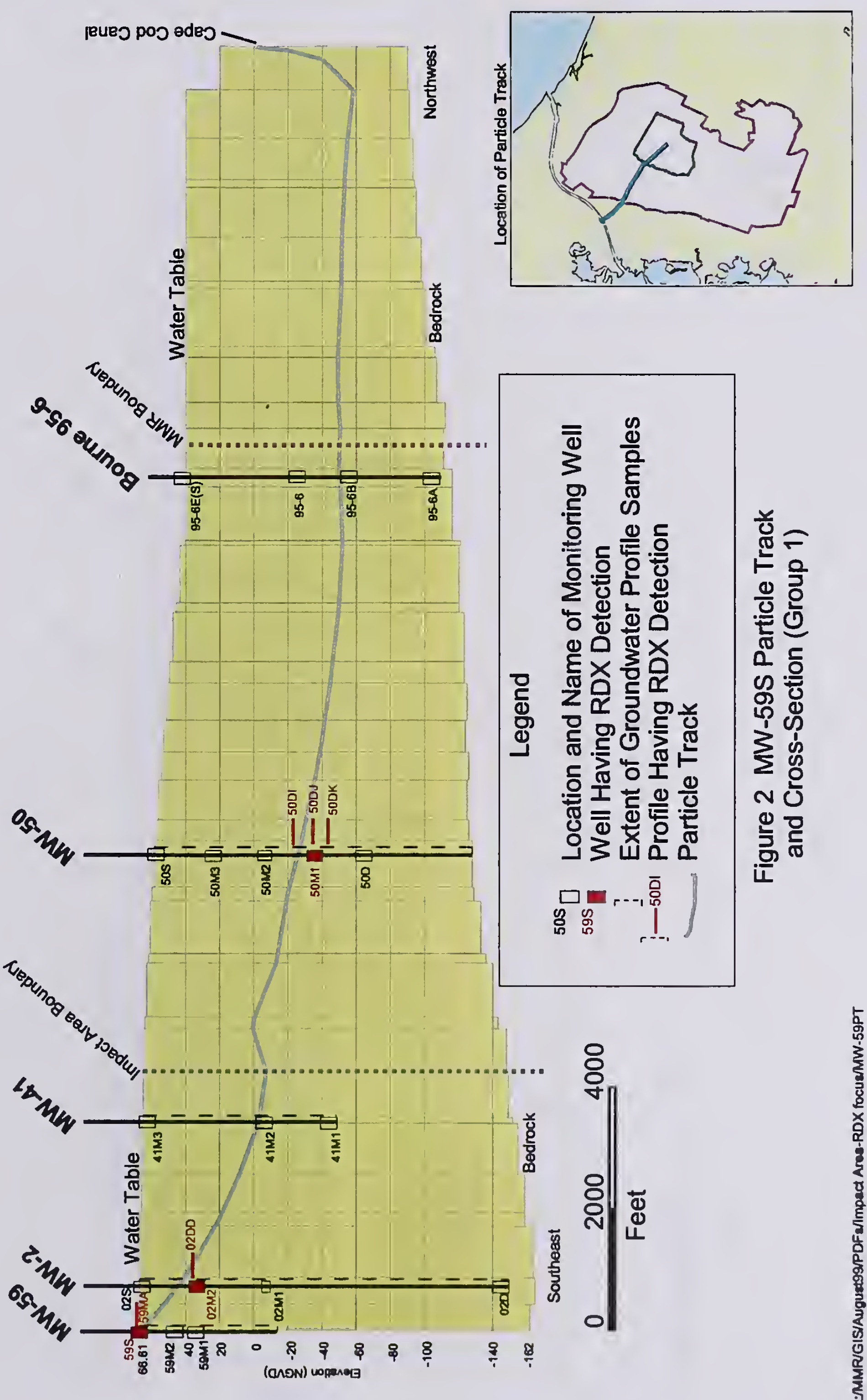


Figure 2 MW-59S Particle Track and Cross-Section (Group 1)

L:/MMR/GIS/August99/PDFs/Impact Area-RDX focus/MW-59PT
G:\MMR\aug99\ptreview.apr
August 17, 1999

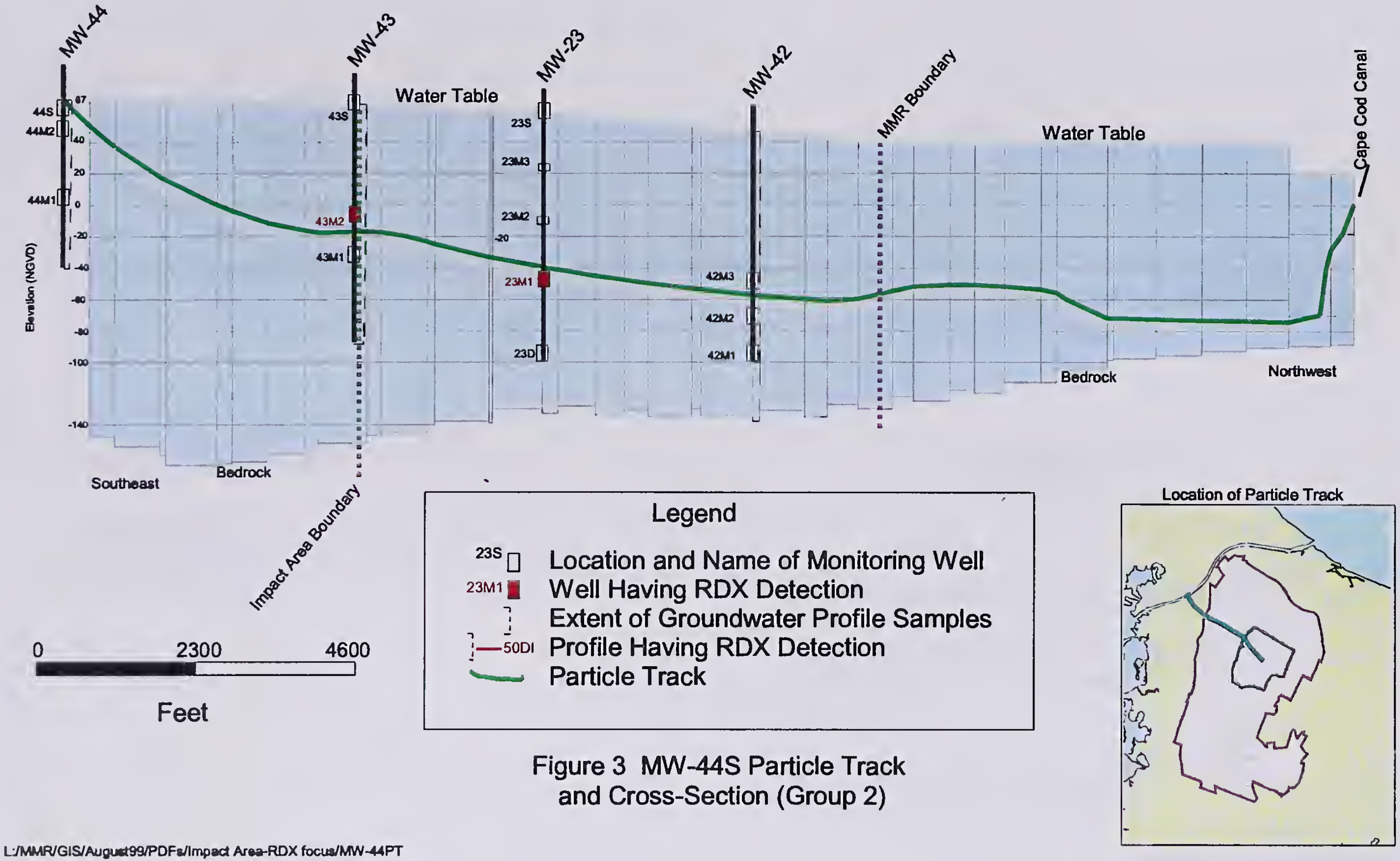


Figure 3 MW-44S Particle Track and Cross-Section (Group 2)

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G:\MMR\aug99ptreview.apr
August 17, 1999

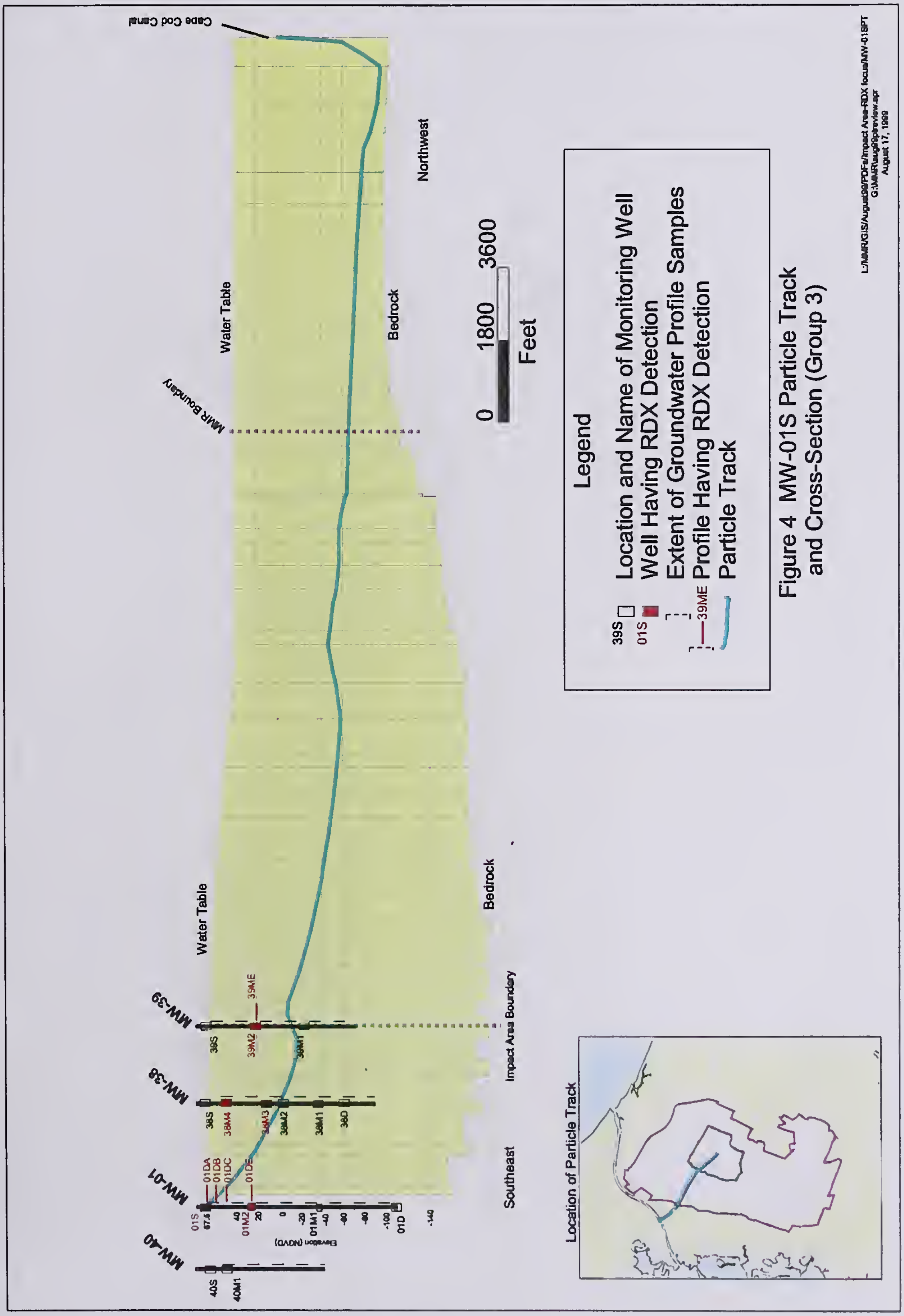

Figure 4 MW-01S Particle Track and Cross-Section (Group 3)

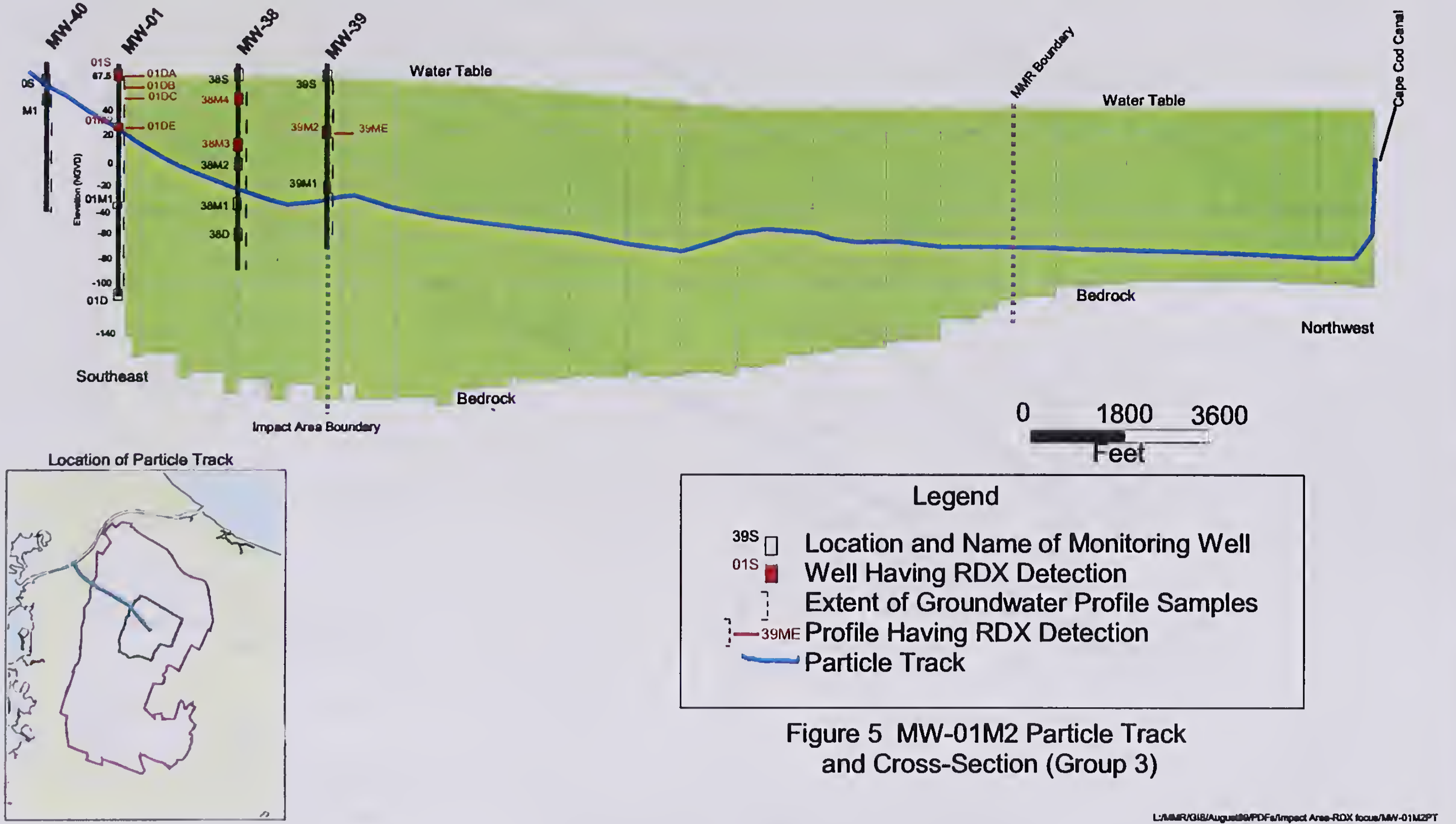

Figure 5 MW-01M2 Particle Track and Cross-Section (Group 3)

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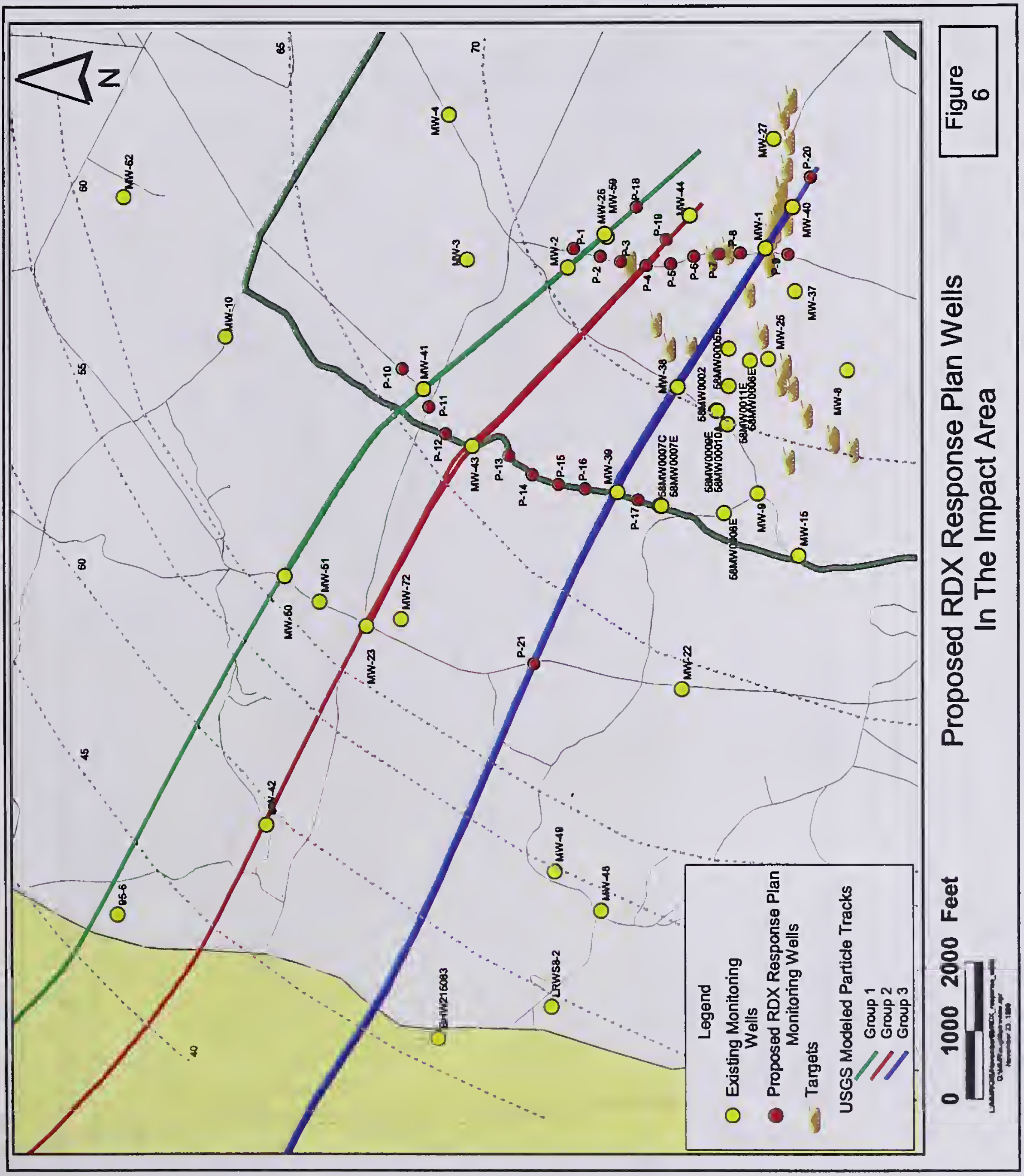
G:/MMR/aug99ptreview.apr
August 17, 1999



Proposed RDX Response Plan Wells In The Impact Area

Figure 6

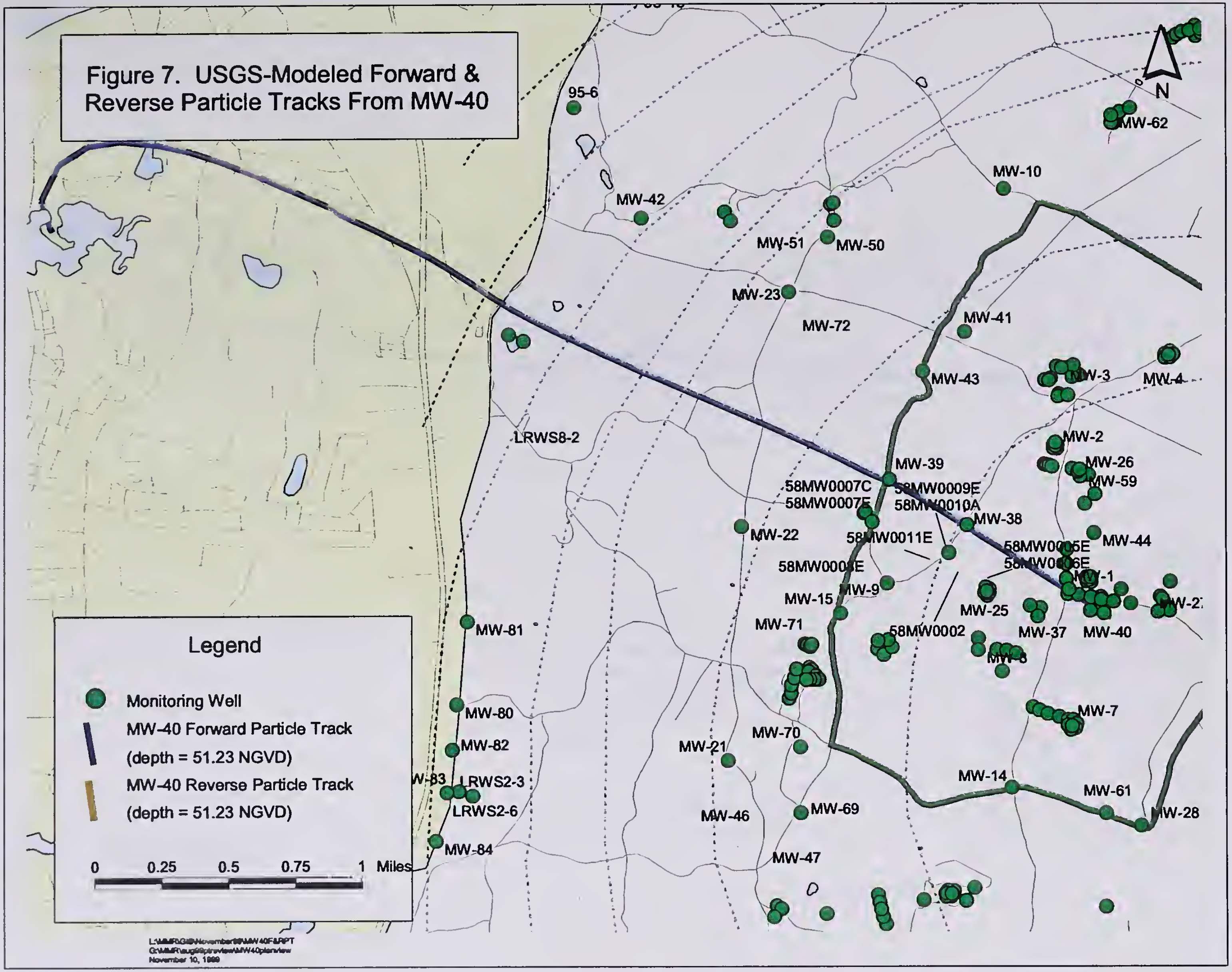
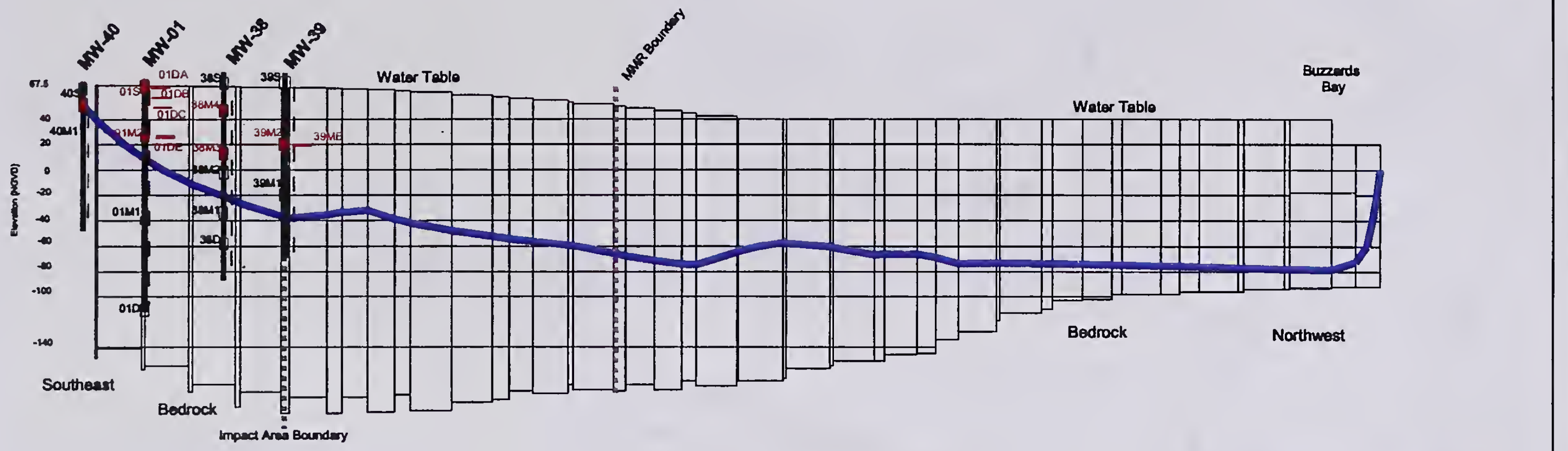
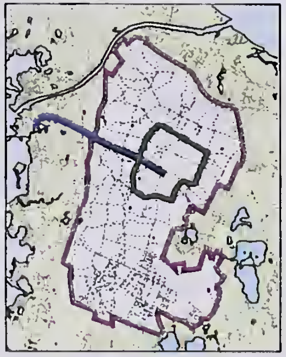


Figure 7. USGS-Modeled Forward & Reverse Particle Tracks From MW-40



Location of Particle Track



Legend

- 23S ☐ Location and Name of Monitoring Well
- 23M1 ■ Well Having RDX Detection
- Extent of Groundwater Profile Samples
- 50DI Profile Having RDX Detection
- Particle Track

Figure 8. MW-40 Particle Track and Cross-Section (Group 3)

L:/MMR/GIS/November99/MW-40PTxs
G:\MMR\aug99ptreview.apr
November 12, 1999

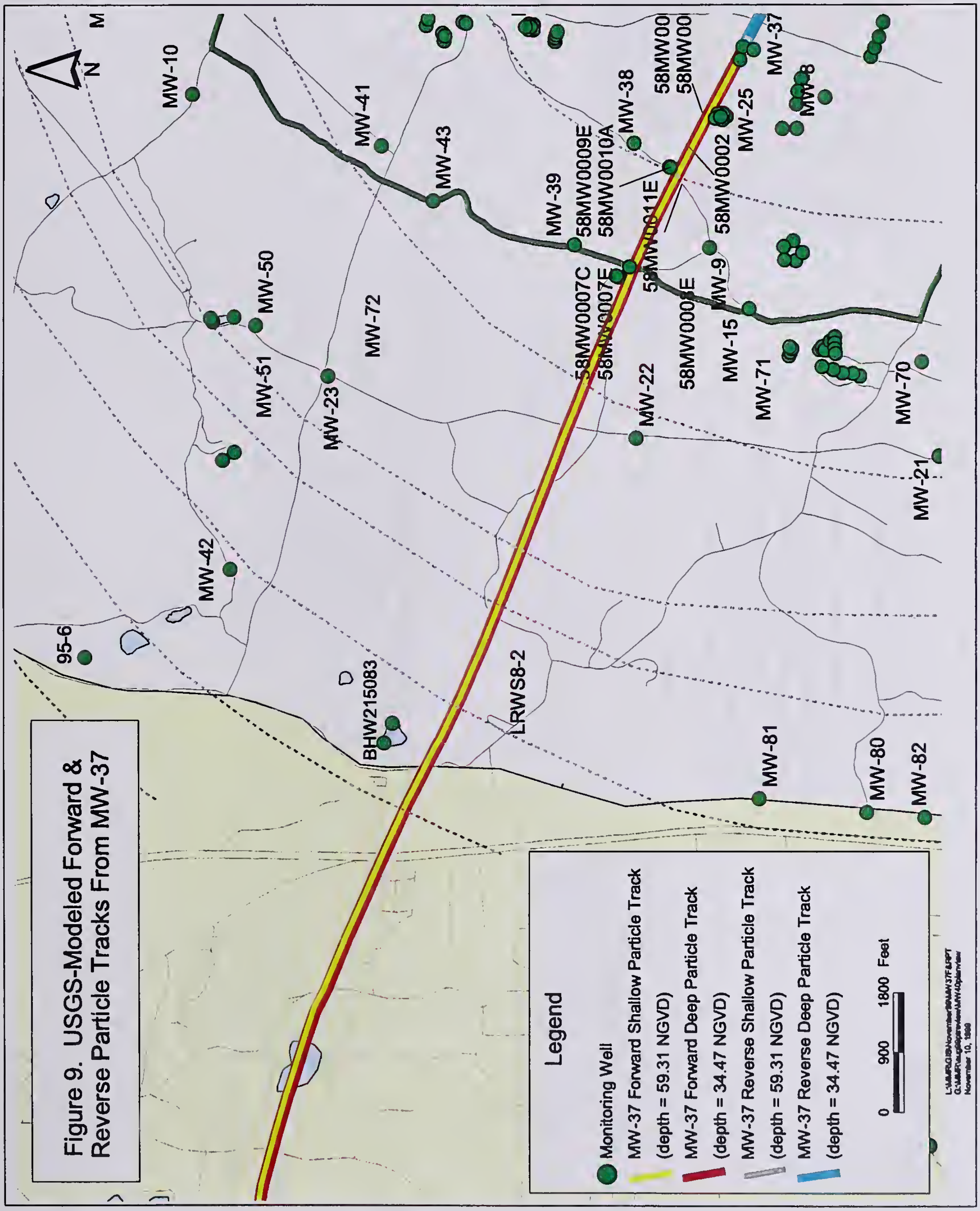


Figure 9. USGS-Modeled Forward & Reverse Particle Tracks From MW-37

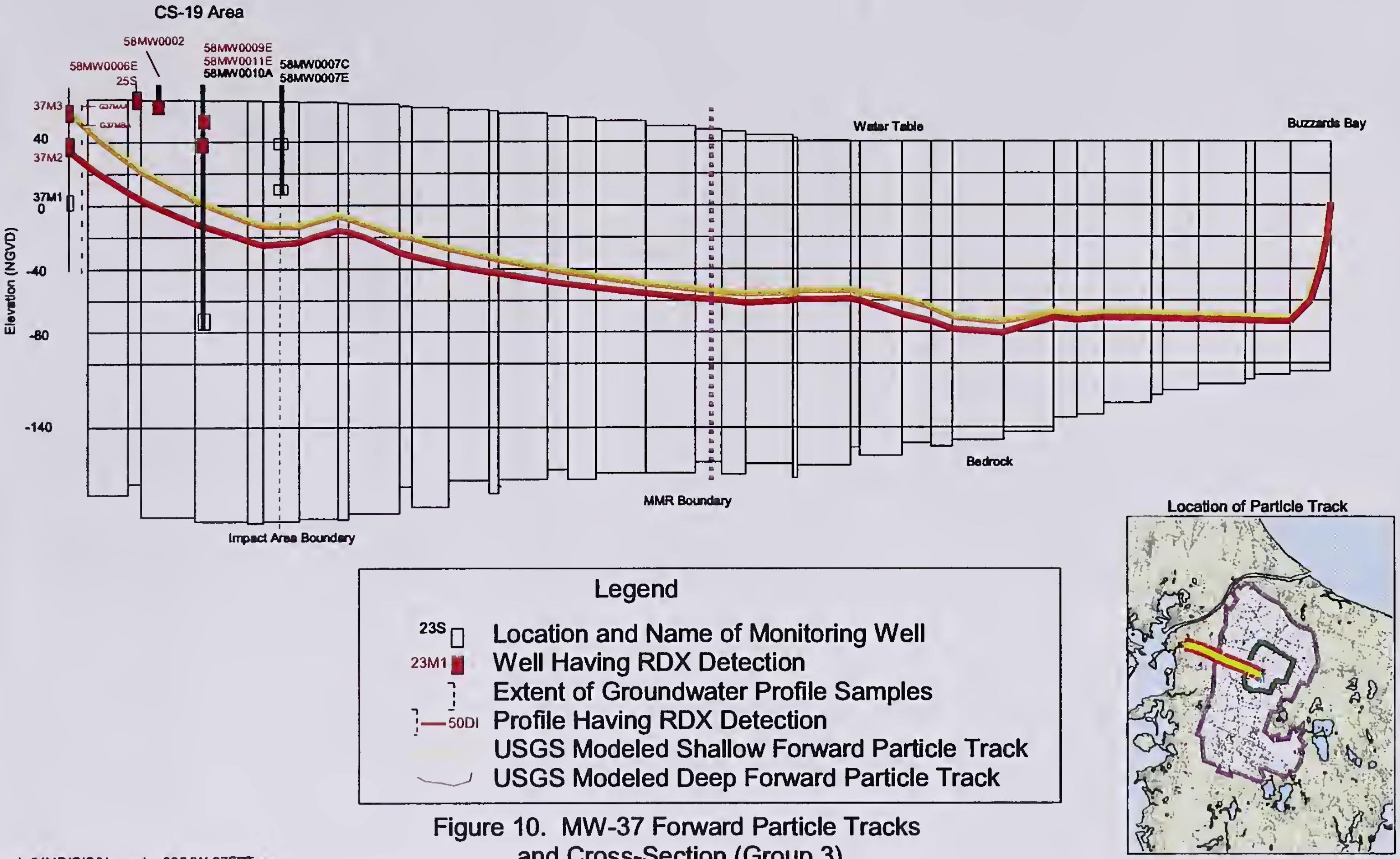

CS-19 Area
58MW0002
58MW0006E
25S
58MW0009E
58MW0011E
58MW0010A
58MW0007C
58MW0007E
37M3
40
37M2
37M1
0
-40
-80
-140
Elevation (NGVD)
Water Table
Buzzards Bay
Bedrock
MMR Boundary
Impact Area Boundary
Location of Particle Track
Legend
23S Location and Name of Monitoring Well
23M1 Well Having RDX Detection
Extent of Groundwater Profile Samples
50DI Profile Having RDX Detection
USGS Modeled Shallow Forward Particle Track
USGS Modeled Deep Forward Particle Track

Figure 10. MW-37 Forward Particle Tracks and Cross-Section (Group 3)

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November 12, 1999

Attachment 1. Draft Soil Sampling Plan for MW-26/59 Location

1. Purpose

Identify the source of groundwater contamination detected in water table wells MW-26 and MW-59.

2. Background

MW-26 and MW-59 are located approximately 50 feet apart in the area southeast of Five Corners, in the Impact Area at MMR. MW-59 is located on the particle backtrack from MW-2M2, which was determined by USGS using the MODFLOW model. RDX and HMX have been detected in these two water table wells, and are also present in MW-2M2 located downgradient from them. Considering the vertical component of groundwater flow, the source of contamination is expected to be near the water table wells.

Several soil samples from this area have been analyzed for explosives. During Phase I of the IAGS, samples from boring 26 were collected from 0-6 inches, 18-24 inches, 10-12 feet, 32-34 feet, 42-44 feet, 51-53 feet, 65-67 feet, 71-73 feet, 83-85 feet, 91-93 feet, 103-105 feet, 111-113 feet, 123-125 feet, 131-133 feet, and 143-145 feet. The upper two samples were non-detect for explosive compounds by EPA Method 8330. The lower samples were non-detect for explosives by the CRREL screening methods, except for intervals 42-44, 71-73, and 91-93 which were non-detect for explosives by EPA Method 8330.

Also during Phase I of the IAGS samples from grids 02K, 02L, and 02M surrounding boring 26 were collected from 0-6 inches and 18-24 inches. These samples were non-detect for explosive compounds by EPA Method 8330.

During Phase II of the IAGS the soil cuttings from boring 59 were composited and analyzed for explosives, along with a composite sample of surface soil scraped from this area during construction of the drill pad. Neither sample had detectable explosive compounds by EPA Method 8330.

3. Proposed Sampling

The Guard proposes to collect additional surface soil samples from the area southeast (hydraulically upgradient) of MW-59, near the end of the particle backtrack from MW-2M2. Each sample will consist of a composite of five subsamples located 30 feet apart and in a line. Each sampling line will be located so that it is perpendicular to and bisected by an extension of the particle backtrack from MW-2M2. Five sampling lines will be installed, starting at the east edge of the MW-59 drill pad and separated by a 30-

foot spacing between lines. Each of the five lines will be sampled at depths of 0-3, 3-6, and 6-12 inches bgs. Each of the 15 composite samples will be analyzed for explosive compounds using EPA Method 8330.

The above sampling will cover an area of approximately 60 by 120 feet on the upgradient side of MW-59. This area will be intrusively cleared for UXO prior to the start of sampling. Additional soil samples may be appropriate in this area based on the results of the UXO clearance, or considering any surface features such as craters, pits, or topographic depressions. The cleared area will be reviewed with the regulatory agencies prior to sampling, to determine the need for additional samples.

Attachment 2. Response to USEPA Comments on the Draft Phase II (a) Response Plan For Impact Area RDX Detections in Groundwater

General Comments:

1. On pages 14-16, and as depicted in Figure 6, EPA has the following request regarding the placement of proposed wells. EPA requests an approach similar to that proposed for Demo-1 be used. This approach would be to drill the proposed wells on either side of the particle tracks first, and base drilling additional wells further out from the particle tracks on the profile results of the first well set. Subsequently, proposed wells not drilled as part of either linear transect can then be drilled in alternate locations chosen in consultation with EPA. More specifically, if it is determined well locations such as P-7, P-5, P-16, and/or P-13 do not indicate explosive compounds, then proposed wells P-6, P-14, and/or P-15 would best be utilized to attempt to bound flow lines in the vicinity of wells MW-23 and MW-50. Several locations which are desirable to have data from in the vicinity of these wells are easily accessed by several roads in that area.

The Guard is in concurrence with the approach suggested, which was our intended approach. Text will be added to clearly outline this approach.

2. As stated in EPA's cover letter, EPA requests that work proposed under NGB's "Draft Soil Sampling Plan for MW-26/59 Location" be wrapped into this "Phase II(a) Response Plan for Impact Area RDX Detections in Groundwater." Therefore, EPA has the following comment on the MW-26/59 workplan: EPA requests that the total size of the area to be sampled be increased. EPA requests that the distance between each sample listed in Section 3 of the MW-26/59 workplan be changed to the following: "Each sample will consist of a composite of five subsamples located *30* feet apart and in a line" (change in italics). EPA expects the results from this soil sampling effort to be evaluated and utilized in subsequent soil sampling plans for the Group 2 and 3 flowpaths. This is the only comment offered by EPA on the MW-26/59 workplan at this time.

The requested change will be made. However, the Guard believes that the soil sampling effort in this case is not likely to be successful for delineating a potential source, considering the following factors:

- *The low rate of vertical groundwater movement makes it difficult to pinpoint source areas using profile measurements and modeling. The average "submergence" rate of 1 foot vertically per 100 feet in the horizontal suggests that a relatively minor variation of 5 feet in the depth of a profile detection would result in a 500-foot change in the estimated location of the source area.*
- *The distribution of explosive in soil at detonation sites appears to be heterogeneous,*

and concentrations appear to be near or below analytical detection limits. This is apparent from the lack of detectable explosives in soil at Areas 1-5 in Phase I of the IAGS, the low levels detected at Demo Area 1, the strong variations in levels at the KD Range primary target, and the sporadic detections at UXO detonation sites. Therefore, even if a detonation site is pinpointed, it is unlikely that detectable concentrations would be measured.

- *A number of potential sources of groundwater contamination could exist that would not be measured through subsurface soil sampling. These could include buried UXO (cache or many individuals) or subsurface waste disposal.*

Considering the above factors, the Guard believes that surface soil sampling has the greatest chance for success in a well-defined source area such as Demo Area 1, or the KD Range primary target. It does not appear that the source of contaminants in MW-26/59 is defined in this way.

3. As stated in EPA's cover letter, the Phase II(a) Workplan requires NGB to fully characterize each area in which contaminants are detected in excess of drinking water standards. As additional information becomes available, EPA expects proposals such as the "Draft Soil Sampling Plan for MW-26/59 Location" for the Group 2 and Group 3 flowpaths. Based on currently available data, a proposal for the Group 3 flowpath would likely be next. These soil sampling plans (and their subsequent results), may be added as an addenda (or in an alternative fashion to be determined by EPA and NGB) to this Response Plan.

See response to General Comment 2 above. Considering the recent results at MW-40Ml, the Guard proposes to implement the groundwater study described in this plan prior to proposing a soil investigation for the Group 3 flowpath.

4. Please incorporate a discussion and evaluation of recent detections of RDX above Health Advisory (HA) levels in monitoring wells MW-37 and MW-40 into this Phase II(a) Response Plan for Impact Area RDX Detections in Groundwater. Please provide a draft copy of this discussion to EPA prior to finalizing this response plan. EPA expects proposals such as the Phase II(a) Response Plan for Impact Area RDX Detections in Groundwater, inclusive of soil sampling proposals such as that for MW-26/59 (and Group 2 and 3 flowpaths, as discussed above in General Comment No. 3), so that all exceedances are addresses by Response Plans within six (6) months of the detection of exceedances.

A discussion of MW-37, MW-40, and MW-44 results will be made prior to the Response Plan with a draft copy provided to the EPA and MADEP prior to finalization of the document. The 6-month time frame envisioned by EPA is a good goal for plan development and implementation. Actual implementation periods may vary due to the investigation approach and interim results.

Specific Comments:

1. Page 4, Section 1.0 - In the first sentence of this section, please insert Bis-(2-ethylhexyl) phthalate after "(RDX)" and delete "other" between "several" and "inorganic." Please double-check to make sure whether additional compounds should be listed.

The suggested changes will be made to the text.

2. Page 4, Section 1.0 – In the third paragraph, please add a statement that RDX contamination in groundwater at the Demo-1 and J Ranges are being investigated separately.

The suggested changes will be made to the text.

3. Page 7, Section 2.1.5 – In the second paragraph, please include a statement based upon recent EPA direction to sample specific PVC wells at 95-6.

The suggested changes will be made to the text.

4. Page 8, Section 2.1.6 – In the second paragraph on page 8, please add a sentence regarding estimated time-of-travel from MW-59 to MW-2M2 based on the particle track information.

A sentence will be added to indicate the time of travel from MW-59S to MW-2M2 is estimated to be 6 years based on the USGS model.

5. Page 9, Section 2.2.3 – Please double check to see whether or not explosives were detected, but not confirmed, in profile samples. If explosives were detected but not confirmed, please elaborate on potential reasons.

Explosives were detected in the groundwater profile samples but not verified with PDA. The last paragraph on page 9 will be reworded to note this fact and potential reasons for the results.

6. Page 10, Section 2.2.5 – In the first sentence of the first paragraph, please correct the sentence to read "MW-42 *was* installed along the forward particle track from MW-23Ml that was modeled by USGS, and MW-44 *and MW-43 were* installed along the reverse particle track from this screen." If this is not correct, please clarify.

The suggested changes will be made to the text.

7. Page 11, Section 2.2.5 – In the third bulleted item on the page 8, please discuss the potential to collect soil samples from grids located in the vicinity of the project source area.

A proposal for soil sampling would be included in Section 3.2, rather than in this section which presents investigation findings. The Guard proposes to install wells upgradient from MW-44 as stated in Section 3 prior to developing a proposal for soil sampling along this flow path. See also the responses to General Comments 2 and 4

8. Page 12, Section 2.3.2 – In the second paragraph of this section, please elaborate on the RDX and HMX detections in profiles which were not confirmed.

The suggested changes will be made to the text.

9. Page 13, Section 2.3.4 – In the first sentence of the second paragraph, change "sample" to "sampled."

The suggested changes will be made to the text.

10. Page 13, Section 2.3.5 – In this paragraph, please discuss relative locations, screen depths, and sampling rounds of wells MW-72 and MW-51.

The suggested changes will be made to the text.

11. Page 14, Section 2.3.5 – In the second paragraph on page 14, please discuss surficial characteristics (topography, disturbed ground, roadways), and the potential to collect soil samples from sampling grids located between MW-1 and MW-39.

The suggested changes will be made to the text.

12. Page 16, Section 3.2 – In the first sentence of the last paragraph on page 16, please change the end of the first line to "…and will *be* determined…"

The suggested changes will be made to the text.

13. Figures 2, 3, and 4 – Please include the Group 1, Group 2, and Group 3 names on these figures.

The suggested changes will be made to the text.

14. Figure 6 – Please include an additional figure (or modify Figure 6), which indicates known targets in the Impact Area in the vicinity of suspected source area. This figure, if separate from Figure 6, should contain much of the same information in Figure 6 (particle tracks, groundwater contours, current and proposed well locations, etc.).

The figure will be modified with the recommended changes.

Attachment 3. Response to MADEP Comments on the Phase II (a) Response Plan For Impact Area RDX Detections in Groundwater

General Comments

The NGB has drawn particle tracks for each of the three groups of wells sampling groundwater originating in the center of the Impact Area and has assigned the designation "Group 1", "Group 2", and "Group 3" wells along each track. For purposes of discussion, Group 1 wells may be considered to lie along "Track 1", Group 2 wells along "Track 2" and Group 3 wells along "Track 3". The NGB has, in the Response Plan, proposed a fence of wells near the source areas (locations P-1 through P-9 along Turpentine Road), and a second fence of wells along the firebreak that marks the Impact Area boundary (locations P-10 through P-17) downgradient from Turpentine Road some 3500 feet. In addition, the NGB has proposed a single well , P-21 at Burgoyne Road along Track 3 , and well locations P-18 through 20 at the upgradient end of each Track to evaluate potential source areas. All proposed well locations are shown on Figure 6 of the Response Plan.

Drilling Sequence

Although the NGB proposal does investigate the lateral extent of detections along each Track at each point of previously detected RDX in groundwater, a sequence of drilling to optimize resources has not been presented. The Department would like to ensure that a sufficient number of wells be proposed in this Response Plan to define the horizontal as well as lateral extent of each area of RDX-contaminated groundwater. The Department suggests the following drilling to optimize RDX response well drilling locations, potentially reducing the number of wells installed near the source areas and reserving them for downgradient contamination extent definition. This approach may provide sufficient data to proceed expeditiously with remedial alternative evaluation.

> *Additional text has been added to the response plan to clarify the drilling approach.*

Evaluation of plume divergence

Data returned very recently from MW-37 suggests that the width of the area of groundwater contaminated with RDX at the southeastern, "source area" end of Track 3 may exceed 750 feet south of the Track. The NGB did not have this data when developing the well array proposed. Drilling locations P-8 and P-9, located within 300 feet of either side of Track 3, were proposed based on the available data. The recent data from MW-37 suggests that the 300 foot spacing may be too close.

Text has been added to Section 3.1 to indicate that if conditions warrant it borings may be relocated or additional borings may be completed.

The Department suggests that initial drilling be performed at a point halfway between Tracks 2 and 3, along Turpentine Road. This location, approximately 500 feet from each Track, corresponds with the NGB's proposed location P-6. If the vertical location and chemical concentration at P-6 confirms overlapping/comingling areas of contamination at this location, then the Department suggests that installation of further lateral-definition wells along Turpentine Road between Tracks 3 and 2 be deferred pending additional downgradient installations along Sandwich Road.

Although this is one viable approach our intention, which is consistent with EPA's suggested approach, is to work south from each Track moving outward. If P-5 or P-8 are free of contamination then P-6 or P-7 would not be drilled, pending concurrence from both regulatory agencies.

Data from downgradient well MW-72M, where explosives were not detected ("ND") in groundwater; and MW-44, at the upgradient end of Track 2 (also ND) suggests that 3 wells to define groundwater quality and plume divergence along Sandwich Road be completed. The Department suggests:

(1) a well along Sandwich Road, halfway between Tracks 1 and 2;

(2) a well, sited halfway between Tracks 2 and 3, and

(3) a well at the point at which Track 2 crosses Sandwich Road.

This well array would address whether (a) the flow lines here are sufficiently divergent that commingled upgradient areas of contamination have separated along three flow lines, and (b) whether the narrow area of RDX in groundwater currently defined as extending along Track 2 from MW-43 to MW-23 is detached from upgradient contamination, or has an upgradient component that may require additional upgradient wells to define.

The Guard disagrees that an additional transect is necessary at this time. The two proposed transects in the Response Plan will address the concern of whether the RDX originates from a single or multiple source. By starting with the easternmost transect the data should provide sufficient detail to determine which borings, P10 through P-17, need to be drilled.

Further downgradient drilling along the firebreak that marks the western Impact Area boundary may then be projected to include the full array of wells proposed (P-13 through P-16) or some lesser number, depending on the upgradient divergence, if present. This approach, which evaluates the near-source divergence of contamination, may result in an improved approach to drilling along the western Impact Area boundary downgradient of the 3 apparently separate source areas. The Department suggests that the NGB budget for the full array of wells proposed in the Plan, with the understanding that some wells may not be required at the locations proposed, and that some wells may be used to better define the downgradient toe of contamination along each of the three Tracks.

The Guard is budgeting for all boring locations with the understanding that the proposed boring locations are preliminary and may be subject to relocation depending on the findings during drilling

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